INTAKE TERRESTRIAL WILDLIFE STUDY
FINAL REPORT

Research Conducted by:
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Ecological Services Division

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INTRODUCTION

As increasing demands are placed on the limited water resources in the Yellowstone River, offstream storage reservoirs are being considered as a more efficient method to use the existing water resource. With offstream reservoirs, water can be removed from the river during high-flow periods instead of the more critical low-flow periods.

However, offstream reservoirs may impact wildlife if they inundate areas of critical wildlife importance. Intake Water Company has proposed construction of an offstream storage reservoir in the Box Elder drainage near Intake. In November 1976, they entered an agreement with the Montana Department of Fish and Game to study the wildlife and habitat use by wildlife in the Box Elder Creek area. Originally, the study was to last seven months, but in May 1977, it was extended to include one full year of field work. The purpose of the inventory was to gather baseline data to evaluate the potential effects of this reservoir.

The objectives of this study as stated in the original agreement were: (1) to prepare a vegetative cover map of the area, (2) to determine seasonal distribution, habitat use, and densities (where possible) of wildlife species inhabiting the area, (3) to conduct studies of migratory birds using the portion of the Yellowstone River which borders the area, and (4) to record the occurrence of species of special interest, such as eagle nests, prairie dog towns, and heron rookeries.

The study was conducted from December 1976 through November 1977 on a 79.8 mi^2 area about 15 miles northeast of Glendive, Dawson County, Montana. The study was designed as a general wildlife inventory and as such was not designed to investigate in detail any one particular species.

Included separately, but as a portion of this final report, are detailed maps of the ten habitat types and surface hydrology of the study area and aerial photographs of the area.

METHODS

All mammalian and avian species observed during this study were recorded, which required a wide range of methods. Semimonthly aerial surveys were used to evaluate distribution and habitat use by ungulates, coyotes and waterfowl. A 150 hp Super Cub was used during these flights and systematic routes were followed. It was necessary to change the route somewhat between winter and the other seasons because the appearance of foliage in spring severely restricted visibility in the riparian and hardwood draw types. The change between winter and summer routes was minor. The riverbottom was surveyed last in winter, but first in summer, so that white-tailed deer could be observed before bedding. Examination of the data suggested that the effects of changing the survey routes were not substantial. Ground surveys, by vehicle and foot, provided additional observations.

All species observed were recorded by group size, habitat type and location (to nearest quarter section). This method was judged to be the most practical to determine habitat preferences of smaller animals due to size and diversity of the area, the survey nature of this study, and time and difficulties involved in censusing birds and mammals. An effort was made to visit habitat types proportionally to their occurrence on the study area. Habitat preference indices were calculated by dividing the percentage of observations in a given habitat type by the percentage of the study area occupied by that habitat type. A value greater than one suggested selection of that type. However, habitat types which comprise only a small portion of the area could have proportionally higher indices than larger types. For example, the maximum habitat preference index for the upland grassland type which comprised about 43 percent of the area would be about 2.3 (100 percent observed used by a species divided by 43 percent of area), whereas the maximum preference index for juniper breaks (3% of area) would be about 33. In this report, the following periods were used to delineate seasons: winter (1 December - 28 February), spring (1 March - 31 May), summer (1 June - 31 August) and fall (1 September - 30 November).

A total of 4,200 trapnights of small mammal trapping effort was accomplished. Traplines consisted of 20 stations with two traps per station, spaced at 15 m intervals. Traplines were placed in all habitat types and were trapped for three consecutive nights, resulting in 120 trapnights per trapline. Peanut butter was used as bait during winter. Rolled oats was added to the bait prior to summer trapping. Bats were collected by shooting and mist-netting over a pond in the riparian habitat type.

Two standard pheasant crowing routes (Gates 1966) were established and censused during the spring by counting the number of cock pheasant calls heard during two-minute stops at one-mile intervals. One was located along the river and the other on the uplands. Sharp-tailed grouse arenas were located and lekking males were censused according to standard procedures (Pepper 1972) during March and April. Males were counted at sunrise on several occasions and the maximum number of males was recorded as the size of the arena. Some of the arenas had to be located and censused from fixed-wing aircraft, because I was not granted access on some land. River islands within the study area were searched intensively for Canada goose nests on 28 April 1977. The results, in conjunction with aerial observations of lone ganders, were used to provide an estimate of breeding Canada geese on the area.

Birds, primarily passerines, were surveyed in the various habitat types during June using standard three-minute counts, a modification of the Breeding Bird Survey technique (Robbins and Van Velzen 1967), i.e. counts were made in as uniform an area as possible and only birds seen and/or heard on the habitat type being censused were counted. These counts were used to determine species composition and relative abundance of

birds in the different habitat types. Two indices of avian community structure were calculated from these data, a diversity index (Shannon and Weaver 1963) and a community dominance index (McNaughton 1967). These indices were considered to be gross indications of avian community structure.

Ten vegetation types were delineated and mapped by Econ Inc. (1977) using false color infrared film. The study area was expanded somewhat to include some river islands not included in the Econ report. Also, the vegetative descriptions of habitat types were expanded from that given by Econ, Inc. (1977). Plant nomenclature follows Stevens (1963) but Montana common names are used.

Scientific names of birds and mammals are listed in Table 18 and Table 19, respectively.

DESCRIPTION OF AREA

The Intake Study Area encompassed 79.8 mi^2. It was located adjacent to, and south of, the Yellowstone River about 15 miles downstream (northeast) from Glendive, Dawson County, Montana. The Intake Diversion Dam was located adjacent to it.

TOPOGRAPHY

The study area was located on the sedimentary plains in eastern Montana (Holder and Pescador 1976) with the present topography mainly a result of soil erosion. The uplands in the southwestern and northeastern portions of the study area were flat to gently rolling. The uplands in the southeast were rolling. The breaks east and southwest of Box Elder Creek were very steep and steep-sided coulees penetrated into the uplands, while the breaks to the Yellowstone River were generally more gentle. The Box Elder Creek bottom and river bottom were flat to gently sloping.

The lowest elevation was under 1990 feet on the Yellowstone River at the northeastern corner of the area. The highest point, Square Butte, was over 2500 feet.

CLIMATE

The climate of Dawson County was described by Cordell (1976). Summarizing, the County generally has a semiarid, continental climate with cold winters, warm summers, and a marked variation in seasonal precipitation. The average daily maximum and minimum temperatures in January, the coldest month, are 27°F and 4°F, respectively, whereas the corresponding temperatures in July, the warmest month, are 90° and 50°.

During a normal year about 80 percent of the annual precipitation (12-14 inches) falls between April and September, with June ordinarily the wettest month. Winter snowfall averages about 28 inches.

The year of study was not typical climatically. There was little snow cover during winter, spring was earlier than normal, and summer was exceptionally dry. From February through July, temperatures averaged 7.0°F above average and precipitation was 5.5 inches below normal. However, from August through November, temperature averaged 2°F below normal and precipitation was 3.3 inches above normal. This atypical weather may have affected habitat selection by wildlife.

SOILS

The soils of Dawson County were described by Holder and Pescador (1976), and their descriptions were summarized for this section. Six major soil associations occurred on the study area:

Trembles-Havrelon Association: This soil association was characteristic of the low terraces and floodplain of the Yellowstone River. These areas were level to gently sloping with deep fine sandy and silt loams underlain by sandy loam and silt loam. The major habitat types in this association were riparian, rose-snowberry, sagebrush grassland, bottom cropland and hayfields.

Cherry Association: This soil association was found on the level to sloping Box Elder Creek bottom. These deep soils were dominated by silty clay loam throughout. Characteristic habitat types were sagebrush grassland, hardwood draw and hayfield.

Lambert-Dimyaw Association: This soil association was found on both sides of the Box Elder Creek bottom and dominated the dissected uplands east of Box Elder Creek. The soils were deep silt loams and silty clay loams underlain by silt loam, silty clay loam or silty clay sedimentary beds. As this soil type typically has many steep-sided coulees, a variety of habitat types was found on it. Upland grassland dominated the more level and rolling sites, big sage xeric hillsides dominated the steep southern and western exposures, and juniperbreaks were common on northern and eastern exposures. A few coulees with springs had hardwoods.

Tinsley-Lambert-Lihen Association: This association dominated the breaks between the Yellowstone River and the uplands south of it from the southwestern corner of the study area to Joe's Island. The soils were generally steep with a northerly exposure. This association consisted of deep, gravely sands and silt loams underlain by thick sand and silt loam sedimentary beds. Many coulees in this association contain springs. The ridges and slopes of this association were dominated by upland grassland and the coulee bottoms by hardwood draws.

Farnuf Association: The level to gently rolling uplands in the northeastern corner of the study area were dominated by this association,

which was characterized by deep soils that have a loam surface layer and a clay loam subsoil, underlain by loam to silty clay loam alluvium. Much of this association was farmed, making the upland cropland type; unfarmed areas were dominated by upland grassland, although hardwood draws were present in the bottoms of the few draws.

Tuner-Beaverton Association: This type was found on the level to gently rolling uplands west of Box Elder Creek. This association was typified by deep soils that have a loam or clay loam surface layer and a clay loam, gravelly clay loam, or sandy clay loam subsoil, underlain by sands or sands and gravel. It was farmed intensively and was dominated by the upland cropland type. The upland grassland type was present on the unfarmed areas.

VEGETATION TYPE

Upland grassland (Number 111 on the habitat map): This was the largest habitat type (21,780 acres), comprising 42.7 percent of the study area. It occurred on the flat and rolling uplands on either side of Box Elder Creek and was dominated by grass. Common grasses and grass-like plants at most sites were blue grama (*Bouteloua gracilis*), needle-and-thread (*Stipa comata*), western wheatgrass (*Agropyron smithii*), prairie junegrass (*Koeleria cristata*) and threadleaf sedge (*Carex filifolia*). Prairie sand reedgrass (*Calomovilfa longifolia*), little bluestem (*Andropogon scoparius*) and sand bluestem (*A. hallii*) were common on sandy sites. Shrubs were not common in this type, but skunkbush and prairie rose (*Rosa arkansana*) were present on hillsides. Half shrubs such as false terragon sagewort (*A. frigida*) and broom snakeweed (*Gutierrezia sarothrae*) were common at many sites. A wide variety of forbs was common on the upland grasslands, including Hoods' phlox (*Phlox hoodii*), prairie thermopsis (*Thermopsis rhombifolia*), white milkwort (*Polygala alba*) Indian breadroot (*Psoralea esculenta*), white wild onion (*Allium textile*), golden-aster (*Chrysopsis villosa*), dotted blazing star (*Liatris punctata*), white upland aster (*Aster ptarmicoides*), purple coneflower (*Brauneria angustifolia*), and prickly pear (*Opuntia polycantha*).

Sagebrush grassland (212): This was the second largest habitat type, encompassing 8,393 acres and 16.4 percent of the study area. It occurred on the Yellowstone River bottom and in all creek bottoms and many swales on the uplands. Characteristic of this type was silver sagebrush (*Artemisia cana*), which occurred in dense to very scattered stands. Common grasses included blue grama, buffalograss (*Buchloe dactyloides*), thickspike wheatgrass (*Agropyron dasystachum*), western wheatgrass and needle-and-thread. Some green needlegrass (*Stipa viridula*) and sand dropseed (*Sporobolus cryptandrus*) were noted. Common forbs and half-shrubs included broomed snakeweed, fringed sagewort, cudweed sagewort (*Artemisia ludoviciana*), common dandelion (*Taraxacum officinale*), gumweed (*Grindelia squarrosa*), common salsify (*Tragopogon dubius*), yarrow (*Achillea lanulosa*), smooth blue aster (*Aster laevis*), white upland aster, peppergrass (*Lepidium virginicum*), blue lettuce (*Lactuca pulchella*) and rush skeleton weed (*Lygodesmia juncea*).

Xeric Hillsides (214 and 211): This harsh habitat type was found on steep south, west and some east exposures and was characterized by the presence of big sagebrush (*Artemisia tridentata*). This type consisted of 6,085 acres and represented 11.9 percent of the study area. A small (198 acres) site of level big sagebrush grassland, delineated separately by Schwartzkopf (1977) was included in this type. Characteristic shrubs, besides big sagebrush, were saltbush (*Atriplex* spp.), *Erigonum multiceps*, broomed snakeweed and, in some areas, rubber rabbitbrush (*Chrysothamus nauseosus*). Few grasses or forbs were present, and large areas were bare of vegetation. Some common grasses and forbs were inland saltgrass (*Distichlis stricta*), blue grama, sideoats grama (*Bouteloua curtipendula*), hoary aster (*Aster canescens*), goldenrod (*solidago* sp.) winterfat (*Eurotia lanata*), and double bladderpod (*Physaria brassicoides*).

Upland Cropland (532): This was a major habitat type on two fairly level upland areas. It consisted of 3,763 acres and 7.4 percent of the study area. Winter wheat (*Triticum aestivum*) was the primary crop, but some barley (*Hordeum jubatum*) was also raised. Half of this type consisted of fallow strips. Some forbs observed in the fields included Russian thistle (*Salsola kali*),and kochia (*Kochia scoparia*). A wide variety of native and introduced grasses and forbs were present at field edges, which were usually ungrazed.

Riparian Forest (401): This type occupied 3,434 acres, 6.7 percent of the study area, and was found on the islands and floodplains of the Yellowstone River. It was characterized by dense stands of plains cottonwoods (*Populus deltoides*), with American elm (*Ulmus americana*) and green ash (*Fraxinus pennsylvanincus*), Wood's rose (*Rosa woodsii*), western snowberry (*Symphoricarpos occidentalis*), western serviceberry (*Amelanchier alnifolia*), chokecherry (*Prunus virginiana*), red osier dogwood (*Cornus stolonifera*), buffaloberry (*Shepherdia argentea*), silver sagebrush Rocky Mountain juniper (*Juniperus scopulorum*) and Virginia creeper (*Parthenocissus inserta*). Common grasses and forbs included Canada wildrye (*Elymus canadensis*), green needlegrass, sand dropseed, needle-and-thread, western wheatgrass, perennial ragweed (*Ambrosia coronopifolia*), lemon scurf pea (*Psoralea lanceolata*), common dandelion, catnip (*Nepeta cataria*), cudweed sagewort, false Solomon's seal (*Smilacina stellata*), poison ivy (*Rhus radicans*), wild licorice (*Glycyrrhiza lepidota*), white prairie aster (*Aster ericoides*) and gumweed.

Hardwood draws (402): This habitat type was found in the bottoms of mesic draws. It occupied 2,785 acres and 5.5 percent of the area. Vegetation varied according to their hydrology and size. Also, different overstory species were found at the heads and mouths of the draws. Characteristic overstory species included (from upper to lower portions of the draws): buffaloberry, wild plum (*Prunus americana*), chokecherry, boxelder (*Acer negundo*), green ash, American elm, and sometimes a few plains cottonwoods. Aspen (*Populus tremuloides*) and river birch (*Betula fontinalis*) were found in some more mesic draws. Common understory shrubs included Wood's rose, western snowberry, western white clematis (*Clematis ligusticifolia*), round-leaved hawthorne (*Crataegus rotundifolia*),

red osier dogwood, skunkbush sumac, wild grape (*Vitis vulpina*), Virginia creeper and golden currant (*Ribes odoratum*). Common grasses and forbs included western wheatgrass, blue grama, thickspike wheatgrass, crested wheatgrass (*Agropyron cristatum*), brome (*Bromus* sp.), bluegrass (*Poa* sp.), common blue violet (*Viola papilionacea*), wild licorice, wild mint (*Mentha arvensis*), wild bergamont (*Monarda fistulosa*), marsh skullcap (*Scutellaria galericulata*), prickly lettuce (*Lactuca serriola*), cudweed sagewort, goosefeet (*Chenopodium* sp.), common dandelion, gumweed and perennial and giant ragweed (*Ambrosia trifida*).

Bottom Cropland (531): This habitat type occupied 2,131 acres, 4.2 percent of the study area, and was located on the river bottom and low benches adjacent to the bottom. It was very similar to the upland cropland type. The major agricultural crops were winter wheat, oats (*Avena sativa*), and irrigated corn (*Zea mays*).

Juniper Breaks (354): This habitat type occupied 1,598 acres, 3.1 percent of the study area. It was generally found in the steep breaks east of Box Elder Creek and was characterized by Rocky Mountain juniper. Other common shrubs were creeping juniper, common juniper (*Juniperus communis*), skunkbush sumac, rubber rabbitbrush, and shrubby cinquefoil (*Potentilla fruticosa*). Common grasses and forbs included sideoats grama, needle-and-thread, cheatgrass (*Bromus techtorum*), threadleaf sedge, harebell (*Campanula rotundifolia*), yucca (*Yucca glauca*), winterfat, white milkvetch,fringed sagewort, yarrow, prairie coneflower, blue flax (*Linum lewisii*) and smooth blue aster.

Hayfields (512): This habitat type covered 726 acres, 1.4 percent of the study area. It was irrigated during summer and mowed for hay. Alfalfa (*Medicago sativa*) and introduced grasses dominated.

Rose-Snowberry (232): This was the smallest habitat type on the study area, occupying only 349 acres, 0.7 percent of the study area, on the river bottom and islands. It was characterized by dense stands of Wood's rose and western snowberry with no overstory. Few forbs were present under the shrub story, but common dandelion and false Solomon's seal were commonly observed.

RESULTS

MULE DEER

Distribution

The general distribution of mule deer did not appear to change through the year (Figure 1). They were apparently most common in the upland areas in the eastern half of the study area, and appeared to be more numerous along the edge and upper reaches of the Box Elder Basin than in the basin itself, except where hardwood cover was available on the basin floor. The latter areas were used primarily in summer and fall.

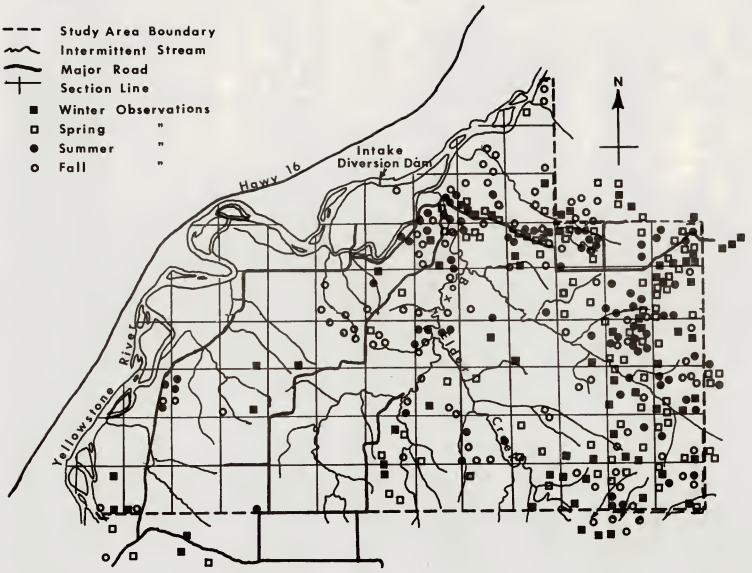

Figure 1. Seasonal distribution of mule deer on the Intake Study Area.

Habitat Usage

Monthly use of habitat by mule deer on the Intake Study Area is summarized by season in Table 1. Seasonal use of topography slope and exposure is presented in Table 2. The data in Table 2 are presented to show season-to-season changes in use of the various topographical features.

Table 1. Seasonal habitat use and habitat preference indices by mule deer on the Intake Study Area.

Habitat Type	Winter (405)[1]	Spring (446)	Summer (153)	Fall(384)
Upland grassland	70[2] (1.6)[3]	60 (1.4)	56 (1.3)	41
Hardwood draws	8 (1.4)	14 (2.6)	15 (2.7)	21 (3.8)
Juniper breaks	10 (3.2)	9 (2.9)	3	17 (5.5)
Sagebrush grassland	8	5	18 (1.1)	12
Xeric hillsides	tr	4	5	3
Upland crops	2	7	3	4
Riparian		tr	1	1
Bottom cropland				1
Rose-snowberry				tr

1/ Sample size

2/ Percent of observations

3/ Habitat preference index; where no preference was found, no index is given.

Winter

During winter, upland grassland, hardwood draws and juniper breaks were the three habitat types selected by mule deer (Table 1). Hillsides and coulee heads were used to a greater degree than during other seasons and use of flat ground was at the lowest yearly level. This may have been related to the distribution of skunkbush sumac and creeping juniper, which appeared to be preferred winter browse species and which were most common on hillsides. Several browse species were also found in coulee heads including snowberry, chokecherry, skunkbush sumac and creeping juniper. The presence of snow may have affected the use of topography and slope (Dusek 1975), although the area did not receive much snow during the 1976-77 winter.

Table 2. Seasonal use of topography, slope and exposure by mule deer on the Intake Study Area.

	Winter (356)[1/]	Spring (402)	Summer (151)	Fall (323)
Topography				
Hillside	44[2/]	43	36	28
Plateau	13	23	16	8
Coulee bottom	11	16	25	28
Coulee head	18	3	11	12
Ridgetop	13	13	7	17
Valley floor		tr	4	4
Creek bottom			tr	3
Slope				
Flat	30	55	57	65
Gentle	24	21	13	12
Medium	25	14	13	11
Steep	21	10	17	12
Exposure				
N	12	14	13	6
NE	12		2	4
NW	7	6	2	5
S	8	7	3	
SE	4		tr	5
SW	6	1	3	3
E	8	10	10	10
W	13	7	8	3

1/ Sample size

2/ Percent of observations.

Spring

Habitat types selected in spring were the same as those used in winter. The use of xeric hillsides (the first type to green up in spring) and upland crops (sprouting winter wheat) increased from winter. The use of hillsides remained high, possibly due to the early green-up, and the use of plateaus and coulee bottoms increased.

Summer

The summer of 1977 was extremely dry. Upland grassland, hardwood draws and silver sagebrush draws were the types selected by mule deer. This possibly reflected the dry condition, because forbs

appeared to remain succulent longer in the hardwood draws and sagebrush bottoms. Similar movements of mule deer to bottom types, including silver sagebrush, in summer have been documented in other studies in Montana (Allen 1968, Martinka 1968, Dusek 1975). Use of coulee bottoms, coulee heads and the valley floor increased from spring.

Fall

Only hardwood draws and juniper breaks, the two cover types used by mule deer, were selected during fall. Upland grassland was not selected and only 8 percent of the deer observed were on plateaus. To determine if hunting had an effect on fall habitat use, observations from this season were divided into those made during the hunting season and those out of season (Table 3).

Examination of Table 3 showed that fall habitat selection by mule deer out of the hunting season was similar to that in summer, except that juniper breaks were also selected. During the hunting season, however, only the two upland cover types, hardwood draws and juniper breaks, were selected. Bucks appeared to select cover types at a

Table 3. Effects of hunting season on fall habitat use by mule deer on the Intake Study Area.

Habitat Type	In Season (23 Oct-20 Nov.)	Out of Season (1 Sept-22 Oct., 21-30 Nov.)
Upland grassland	29[1/]	52 (1.2)[2/]
Hardwood draw	29 (5.3)	13 (2.4)
Juniper breaks	27 (8.7)	9 (2.9)
Sagebrush grassland	6	17 (1.0)
Xeric hillsides	3	3
Upland crops	7	1
Riparian		2
Bottom cropland		2
Rose-snowberry		tr
Observed sex ratio (males:100 does)	19	39
Sample size	161	187
Average Group size	3.4	3.3
"Covertypes" Hardwood draws, Juniper breaks	56% (6.5)	22% (2.6)

1/ Percent of observations

2/ Habitat preference index, where no preference was found, no index is given.

differentially greater rate. This was suggested by the observed sex ratios, 19 bucks:100 does during the hunting season and 39:100 out of season. This also suggested that the relative use of cover types during the hunting season was greater than that observed because of the hiding behavior of bucks at that time. During the 1977 season bucks were hunted on a limited permit basis on the study area and does were protected.

Mule deer may have been especially vulnerable to hunting on this study area, because over 56 percent of the mule deer concentrated on only 8.6 percent of the study area during the hunting season. Thus, a reduction in the amount of cover available, would probably further concentrate deer on the limited cover types and may make them more vulnerable to hunting and other forms of predation. A. Dood (pers. comm.) found that mule deer fawns may have been less vulnerable to coyote predation in the Missouri River Breaks when they used denser timbered cover types.

Most studies of habitat use by mule deer in Montana have been carried out where at least some habitat types have been dominated by coniferous forest, primarily ponderosa pine in eastern and central Montana. Unfortunately, quantitative data on mule deer are generally lacking for the non-timbered, short-grass prairie habitat which predominates much of the eastern two-thirds of Montana (Dusek 1975). To put the results of this study in perspective, the relative importance of cover types to mule deer in the fall was compared with several other areas in eastern Montana, all of which contained ponderosa pine. The results (Table 4) indicated that mule deer on this study area showed a relatively greater use of timbered types in fall compared with other seasons than did mule deer in the nine other areas. This may suggest

Table 4. Relative importance of timbered habitat types to mule deer during fall in several areas in eastern Montana.

Area	Index of Relative Fall Use Of Timbered Types[1/]	Percent of Fall Use Observed In Timbered Types	Source
Decker	0.2	5	Knapp 1977
Bull Mountains	0.2	5[2/]	Dusek 1976
Ashland	0.3	24	Knapp 1977
Bear Paw Mountains	0.4	7	Martinka 1968
Hanging Woman Creek	0.6	26	Knapp 1977
Upper Otter Creek	0.8	32	Knapp 1977
Sarpy Creek	0.8	44	Martin 1976, 1977
Canyon Creek	0.9	86	Knapp 1977
Missouri Breaks	1.1	43	Mackie 1970
Box Elder Creek	2.0	39	This study

1/ Index = Percent use of timbered types in fall divided by average percent of use of timbered types in spring, summer and winter.
2/ Most fall observations made prior to the hunting season.

that adequate escape cover in the fall was more limited in this study area than in the others where ponderosa pine was present and that the timbered upland habitat types on this area represented critical escape cover for mule deer during the hunting season.

Population Characteristics

Mule deer production and population characteristics are summarized in Table 5. Eustace (1974) gave the following criteria for the ranking of fall mule deer fawn:doe ratios: 40-59 fawns:100 does, poor; 60-70:100, fair; 80-99:100, good. According to this, the production in 1976 was fair to good. Based on the changes in fawn:adult ratios between winter and spring, overwinter fawn mortality appeared to be about 18 percent. Production in 1977 was very poor, only 34.1 fawns:100 does. Mackie (1972) reported that 50-55 fawns:100 does would maintain a stable mule deer population in the Missouri River Breaks. If the Box Elder Creek population is subjected to similar mortality rates, the observed production would not be adequate to maintain the population.

Prior to the 1977 hunting season, a sample (141) of the mule deer population consisted of 26 percent bucks, 60 percent does and 14 percent fawns. The results for fall 1977, presented in Table 5, are somewhat different during the hunting season because bucks were more difficult to observe than does.

Table 5. Deer production on the Intake Study area.

Species		Sample Size	Fawns: 100 Does	Fawns:100 Adults	Males: 100 Does	Percent Fawns
Mule deer	Winter 1976-77	281	73.6[1]	54.4	29.1[1]	35
Mule deer	Spring 1977[2]	49		44.5		31
Mule deer	Fall 1977	206	34.1	27.2	25.6[4]	21
White-tailed deer	Winter 1976-77	282	88.2[5]	66.9	38.2[5]	40
White-tailed deer	Spring 1977[2]	154		71.1		42
White-tailed deer	Fall 1977[3]	222	83.2	73.7	24.0[6]	42

1 December + January
2 March - first 1/2 of April
3 October + November
4 Before season (1 Sept.-22 Oct.) = 44.0, during season (23/10 - 20 Nov) =18.9
5 December
6 Before season (1 Sept.-22 Oct.) = 26.9, during season (23 Oct.-20 Nov.)= 20.7.

WHITE-TAILED DEER

Distribution

White-tailed deer distribution seemed to remain relatively constant throughout the year on the study area (Figure 2), although some movements and changes in areas of concentration seemed to take place. Whitetails were found primarily on the valley floor, although the adjacent uplands received some use. The greatest whitetail densities occurred where alfalfa and grain fields were located near large stands of riparian cover.

Movements

Some whitetails moved from hardwood draws and the river bottom to the upland wheatfields to feed during winter. This may have been related to snow cover, because the sown strips of the upland fields were blown free of snow, while the lower fields remained covered. Some whitetails were observed in hardwood draws and other areas off the valley floor each season as Allen (1968) also reported, but only 2-12 percent of the whitetails observed were not on the valley floor.

Habitat Use

Seasonal habitat use and season use of topography are presented in Table 6 and 7, respectively. The use of topography was similar throughout the year.

Table 6. Seasonal habitat use and habitat preference indices by white-tailed deer on the Intake Study Area.

Habitat Type	Winter (1560)[1]	Spring (2724)	Summer (1422)	Fall (825)
Riparian	54[2] (8.1)[3]	6	13 (1.9)	24 (3.6)
Rose-snowberry	tr	1 (1.4)	8 (11.4)	8 (11.4)
Hayfields (haystacks)	4 (10) (2.9)	47 (33.6)	63 (tr) (45.0)	32 (tr) (22.9)
Bottom croplands	15 (3.6)	36 (8.5)	5 (1.2)	22 (5.2)
Upland crops	7	3		
Sagebrush grassland	7	4	8	11
Hardwood draw	3	1	2	4
Juniper breaks			tr	
Upland grassland		1	tr	
Xeric hillsides			tr	

1 Sample size
2 Percent of observations
3 Habitat preference index, where no preference was found, no index is given.

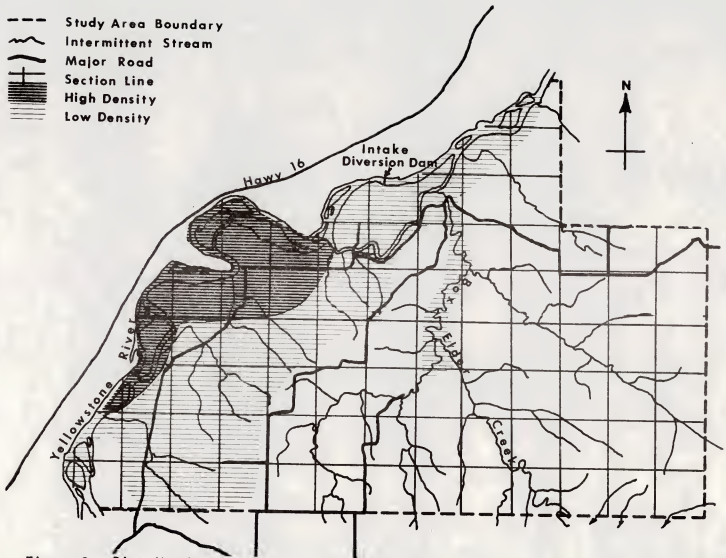

Figure 2. Distribution of white-tailed deer on the Intake Study Area.

Table 7. Seasonal use of topography by white-tailed deer on the Intake Study Area.

Topography	Winter (1535)[1]	Spring (2583)	Summer (1534)	Fall (813)
Valley floor	88[2]	96	98	97
Coulee bottom	2	1	1	2
Coulee head	1	tr	tr	1
Plateau	7	3		
Hillside	1	tr	tr	
Ridge	tr	tr		
Creek bottom	tr			tr

[1] Sample size
[2] Percent of observations

Winter

The cottonwood type, hayfields and bottom croplands were the types selected by whitetails during winter. During the period of snow cover, haystacks were utilized to a large degree, accounting for 10 percent of the winter habitat use. The use of the cottonwood type was similar to that reported by Allen (1968) on the Missouri River.

Spring

The most important habitat types in spring appeared to be alfalfa and bottom croplands (winter wheat). Actually, the use of wheat increased from February through March as the snow melted and wheat became available but use of wheat decreased as alfalfa became green. The low value for the cottonwood type was probably due to reduced observability after the appearance of foliage (Allen 1968, Martinka 1968).

Summer

The hayfield habitat type received the most use during summer and use of rose-snowberry and riparian types increased. The whitetail's preference for alfalfa has been well documented in Montana (Allen 1968, Martinka 1968) and depredation problems resulted on the study area. Increased use of rose-snowberry may have been due to greater forb desiccation in other types.

Fall

In fall, bottom croplands increased in importance as alfalfa desiccated and decreased in importance. Rose-snowberry was used at the same level as in summer and use of the cottonwood type increased.

Population Characteristics and Productivity

White-tailed deer productivity (Table 5) was greater than that of mule deer and was more stable from 1976 (88.2 fawns:100 does in winter) to 1977 (83.2 fawns:100 does in fall). There appeared to be very low overwinter mortality among the fawns since the fawn:doe ratio increased from 66.9:100 in winter to 71.1 in spring.

A sample (N=449) of the whitetail population consisted of 18 percent males, 45 percent females and 37 percent fawns before the hunting season and 9 percent bucks, 50 percent does and 41 percent fawns after the general hunting season (N=58).

The sample size of whitetails classified after the season was small, but an attempt was made to calculate population size using the change in proportion of bucks and estimated kill of bucks. The general season harvest was about 44 whitetail bucks on the study area and the harvest was primarily composed of bucks. From this 88 bucks were estimated to be on the area prior to the hunting season, or a total of 488 whitetails. The calculated density was 30.5 whitetails/mi^2 of whitetail habitat. There were several indications of a high whitetail population, besides the depredations on alfalfa. The highest number of whitetails seen during a flight was 279 on 31 January. This was 68 percent of the calculated pre-fawning population. On 23 August, 150 whitetails were seen feeding on one small alfalfa field; this was 31 percent of the estimated population.

Interspecific Deer Relations

Allen (1968) and Martinka (1968) have concluded that there was little interspecific competition between mule deer and whitetails on their study areas. The results of this study support their conclusions. There was no overlap in selected habitat types on this area (Table 1 and 6). From 88-98 percent of whitetail observations were on the valley floor whereas only 0-4 percent of mule deer observations were on the valley floor. In winter, when 12 percent of the whitetail observations were away from the valley floor, 7 percent of the use was on upland croplands. Only 2 percent of the winter mule deer use was on upland croplands. This segregation based on differential selection of topography and habitat types precluded interspecific competition at the present population levels.

Effects of Epizootic Hemorrhagic Disease

A large number of white-tailed deer died on the study area in summer 1977. Examination of a few quite freshly dead deer revealed symptoms similar to those of epizootic hemorrhagic disease:

good condition, blood at the nose and mouth, many dead deer found in or near water, the die-off coinciding with hot weather and continuing until cold weather (Richards 1976). Data were collected to determine the effects of this disease on the deer population.

A total of 72 dead deer which probably died from this disease were located. All but one (1.4%) were whitetails; one sick pronghorn antelope was also observed. The die-off began in late July and appeared to decrease in late August and early September, with a few deer dying in September and October. To determine the extent of the die-off, I marked 14 deer skeletons on a subarea prior to the hunting season and asked the hunters there to mark the skeletons they found on this subarea, take a mandible and report the sex. They reported an additional 37 dead deer (excluding bleached remains). I had located 27 percent (14/14+37) of the dead deer on this subarea. Since I located a total of 34 dead whitetails on the entire area, I used the 27 percent location success to estimate a total of 124 dead deer. This is minimal since I located three carcasses on the subarea after the hunters had left, all of which were unmarked.

The age structure of known-sex white-tailed deer which died from the disease was compared with ages of hunter-killed whitetails (Figure 3). Disease mortality did not seem to be age specific for bucks, but appeared differentially greater for 3½-year-old does and relatively less for younger and older does. Only one fawn which died during this period was found, but dead fawns are probably harder to find and more easily devoured by scavengers. The fawn:doe ratio was only slightly less in fall 1977, 83:100, than in winter 1976-77, 88:100. This suggested that fawns were not differentially killed by the disease, but that the fawns of disease-killed does probably died.

Using the December and January classification data for 301 white-tailed deer, and assuming a 50:50 sex ratio for fawns, a spring sex ratio of 29 percent males and 71 percent females was calculated. The sex ratio of dead deer was 33 percent males and 67 percent females, indicating no sex selectivity. The calculated sex ratio in the fall, after the disease, but before the hunting season, was also 29 percent males and 71 percent females.

The estimated loss of 124 deer included only adult deer, but the data suggested that the does' fawn(s) also succumbed. Using the sex ratio of dead adult deer and the fall fawn:doe ratio, the minimum "effective" kill caused by the disease was calculated to be 194 white-tailed deer. Since the vast majority of white-tailed deer observations occurred on about 16 mi^2 of river bottom, this represents a minimum loss to the fall population of 12 whitetails/mi^2 of whitetail habitat, an estimated one-third of the population. In the South, much higher rates of mortality due to hemorrhagic disease have been recorded, up to 84 percent (Prestwood et al. 1974).

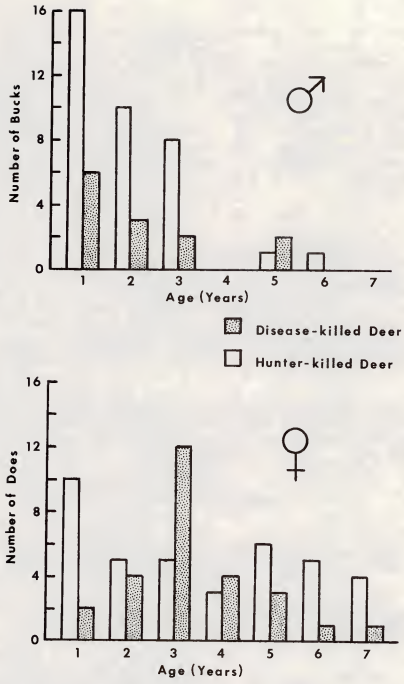

Figure 3. Comparison of age structures of disease-killed (summers) and hunter-killed (fall) white-tailed deer.

The disease mortality was apparently not density dependent on the study area. Summer distribution of live deer, based on aerial surveys in July, August and September and the distribution of dead deer, located prior to the hunting season, is compared in Figure 4. The four river sections were 4 distinct habitat complexes. The correlation did not suggest density dependent mortality. In this regard, it is interesting that Hamlin (1977) noted a 30 percent decline in a white-tailed deer population on an upland agricultural area near Terry during 1976, perhaps due to the hemorrhagic disease. The whitetail population there was much sparser than that on the study area.

PRONGHORN ANTELOPE

Distribution and Movements

A herd of 33 antelope wintered on upland winter wheat fields in the southwestern portion of the study area and a small portion of the winter range of a herd of 40 antelope was included in the southeast corner (Figure 5). Observations from spring, summer and fall were concentrated in the winter area and to the north, primarily on upland grassland and croplands.

Some antelope which wintered on the area apparently dispersed from the area in the spring, probably towards the south. There were some indications that antelope moved from the area, probably to the more rugged country to the south, during the hunting season.

Habitat Use

Seasonal habitat use of the pronghorn on the study area is presented in Table 8. Only two types were important: upland cropland (wheat) in winter and spring and upland grassland in summer and fall.

Table 8. Seasonal habitat use and habitat preference indices by pronghorn antelope on the Intake Study Area.

Habitat Type	Winter (712)[1]	Spring (248)	Summer (92)	Fall (141)
Upland crops	79[2] (1.1)[3]	71 (6.8)	14 (1.9)	45 (6.1)
Upland grassland	21	29	75 (1.8)	55 (1.3)
Sagebrush grassland			4	
Bottom crops		tr		
Group size	29.7	7.1	3.5	8.8

1 Sample size
2 Percent of observations
3 Habitat preference index, where no preference was found, no index is given

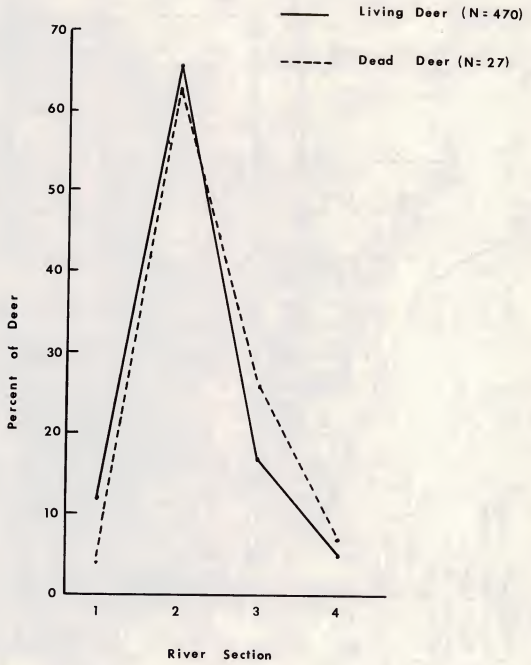

Figure 4. Distribution of living and disease-killed white-tailed deer in four habitat complexes along the Yellowstone River, summer 1977.

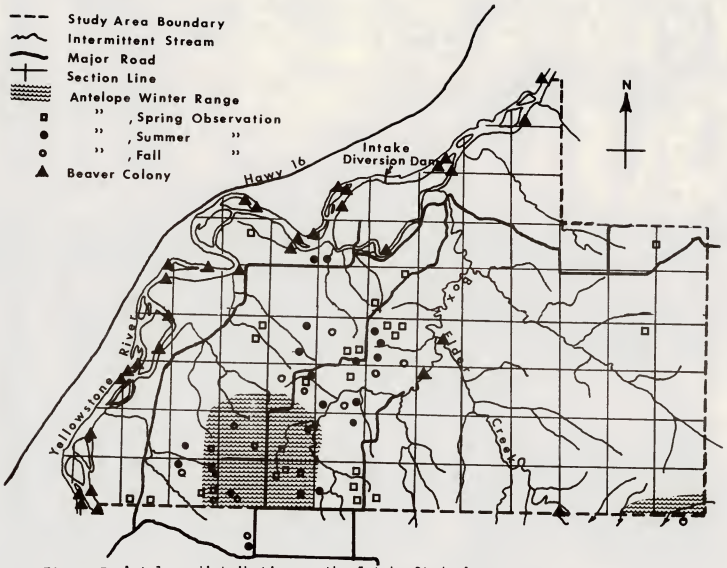

Figure 5. Antelope distribution on the Intake Study Area.

Antelope left the wheat fields abruptly in mid-April, coinciding with forb greenup. They began to use these fields again in mid-July, after the harvest. This early use may have been related to the desiccated condition of the forbs, because they left the stubble fields in early September, after the area received substantial rainfall. Antelope began using wheat fields again in mid-October and use increased during November.

The study area appeared to contain marginal winter antelope habitat. In general, antelope in Montana require sagebrush grasslands. They use big sagebrush and silver sagebrush habitat types in winter, when these two shrubs provide the bulk of their food, and use grasslands to a greater degree in summer, when forbs are the most important food (Cole and Wilkins 1958, Bayless 1969, Knapp 1977). Very little sagebrush was available in the areas used by antelope on this study area and wheat was apparently substituted for sagebrush as a winter food, as Cole and Wilkins (1958) suggested was possible. Cole and Wilkins (1958), when comparing two study area subunits found that increased use of croplands was related to decreased availability of sagebrush.

Winds kept the seeded wheat strips free from snow on this study area and the antelope herd appeared to suffer little winter mortality. However, during a period of deep snow, the antelope would probably leave the fields (Cole and Wilkins 1958) and, without an available supply of big or silver sagebrush, could suffer heavy winter mortality as was recorded in northern Montana by Martinka (1967).

Population Characteristics

Summer and fall population characteristics are presented in Table 9. Although sample sizes were small, the substantial increases in fawn:doe ratios (49 vs 73) and buck:doe ratios (14 vs 23) between summer and fall, perhaps reflected a movement of antelope with greater productivity onto the area in fall. An increase in numbers was also noted, but fewer antelope were classified during fall.

Table 9. Population characteristics of the pronghorn antelope on the Intake Study Area in 1977.

Season	Sample Size	Bucks	Does	Fawns	Fawns: 100 Does	Bucks: 100 Does
Summer (July-Aug.)	48	4	29	14	48	14
Fall (Sept.)	43	5	22	16	73	23

SHARP-TAILED GROUSE

Distribution

During the winter, sharp-tailed grouse were found throughout the study area, except in extensive cropland areas, where they only used the edges of fields. They were generally less common on the river bottom than on the uplands or breaks. During spring and summer, they were found on the uplands or in the creek and coulee bottoms (Figure 6).

Seasonal Habitat Use

Sharp-tailed grouse are characteristic of brushy grasslands and brushy, deciduous cover is of paramount importance to them (Brown 1971). Seasonal habitat use by sharptails is summarized in Table 10. Sharptails were most widely dispersed during winter, and this was the only season they were observed with any regularity on the valley floor (Table 11). They moved to the uplands in spring and used upland grasslands and croplands almost exclusively. During summer, silver sagebrush grasslands began to receive more use, and this trend continued into fall, when hardwood draws also began to receive increased use, possibly due to forb desiccation. Field observations indicated that forbs remained succulent longer in the more mesic hardwood and sagebrush draws.

From December through April, habitat use was determined during semimonthly intervals to determine the effects of the following variable on habitat use: snow cover, onset of lekking, grass green-up and forb green-up (Figure 7). It appeared that croplands were important during winter while grain was available. During the period of snow-cover, hardwood draws became important and use of this type seemed to compensate for the loss of the grain. The sharptails were apparently forced to the hardwood draws by snow cover which made grain unavailable, suggesting that the hardwood draw habitat type was a critical winter habitat type for sharp-tailed grouse on this study area. In late January, I placed 100 pounds of wheat on an abandoned feeding area in a grain field to try to attract birds for trapping. A flock of 70 grouse soon began feeding on the bait. Forty-three of these were captured on 1 and 2 February, leaving 27, but 57 were observed there on 14 February. Fields were used again as soon as the snow melted, and bottom croplands were used extensively for the first time. This may be due to the location of the hardwood draws between the upland and bottom croplands. Sharptails left the bottom croplands by late February, but did not begin leaving the upland croplands until the beginning of forb greenup. Grass greenup and the onset of lekking activities were apparently unimportant in determining habitat use of foraging grouse.

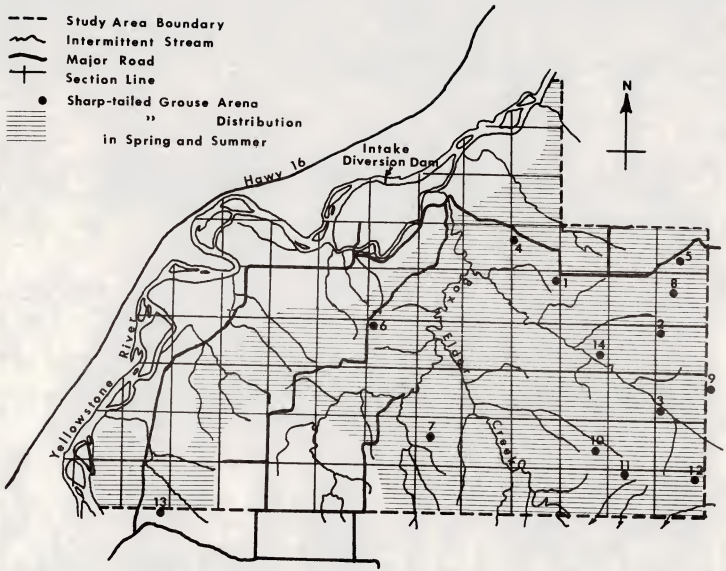

Figure 6. Locations of sharp-tailed grouse arenas and spring-summer grouse distribution on the Intake Study Area, spring 1977.

Table 10. Seasonal use of habitat types by sharp-tailed grouse on the Intake Study Area.

Habitat Type	Winter (1220)[1]	Spring[2](942)	Summer (278)	Fall (419)
Upland grassland	28[3]	54 (1.3)[4]	63 (1.5)	55 (1.3)
Hardwood draws	15 (2.7)	4	2	12 (2.2)
Upland croplands	36 (4.9)	37 (5.0)	27 (3.6)	16 (2.2)
Bottom croplands	15 (3.6)			4
Juniper breaks	2	1		1
Silver sagebrush grassland	2	4	8	12
Riparian cottonwood	3			

1 Sample size
2 Excluding observations of lekking males
3 Percent of observations
4 Habitat preference index, where no preference was found, no index is given.

Table 11. Seasonal use of topography, slope and exposure by sharp-tailed grouse on the Intake Study Area.

Topography	Winter (767)[1]	Spring (810)	Summer (234)	Fall (401)
Plateau	42[2]	61	56	60
Ridgetop	9	14	22	4
Hillside	7	13	13	10
Coulee bottom	16	11	7	12
Coulee head	3	tr	2	7
Valley floor	23	tr	-	7
Slope				
Flat	86	87	87	86
Gentle	3	7	8	12
Medium	10	5	4	1
Steep	1	tr	1	
Exposure				
Flat	86	87	87	86
N	3	tr	3	4
S	tr	6	5	-
E	tr	3	tr	1
W	1	1	5	5
NE	5	-	-	4
NW	3	1	-	tr
SE	-	1	tr	-
SW	1	tr	-	-

1 Sample size
2 Percent of observations

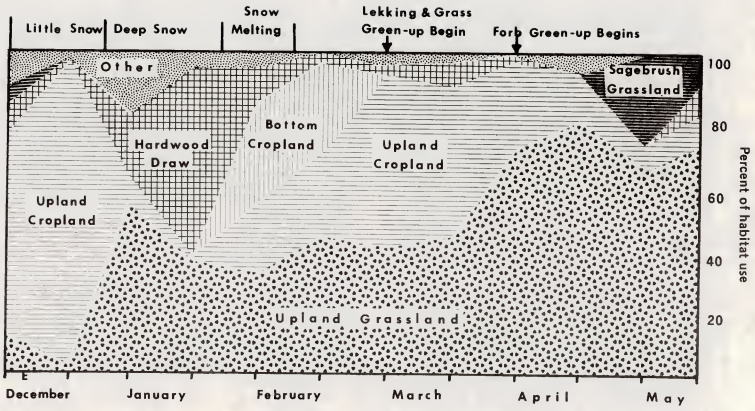

Figure 7. Habitat use by sharp-tailed grouse on the Intake Study Area during semi-monthly periods in winter and spring.

Winter Food Habits

From the results presented above, it is obvious that hardwood draws were essential for sharptails during winter when grain was unavailable. A late frost in spring 1976 caused a berry failure, so the sharptails may have utilized grain more than during normal years (Evans 1968). To determine which plant species were important as winter food, all instances of feeding during winter were recorded (Table 12). Instances of "probable feeding" included birds flushed suddenly from shrubs or trees, or observed from an airplane, so feeding was not positively verified, but probably occurred. The only fruits available were on rose, Russian olive and junipers; otherwise buds were consumed. Russian olive is an introduced species which was preferred, although very limited on the area. Disregarding grain and Russian olive, plants characteristic of hardwood draws (buffaloberry, chokecherry, green ash) accounted for 38 percent of the feeding observations, those characteristic of upland grasslands (skunkbrush sumac, creeping juniper) accounted for 33 percent, those of the river bottom (rose, cottonwood, snowberry, willow, elm) 14 percent and those of juniper draws (Rocky Mountain and common junipers) 12 percent. The crop of an adult sharptail killed by a predator on 23 February 1977 contained 145 individual food items, including 58 percent buffaloberry terminal twigs with buds, 38 percent wheat kernels, 3 percent chokecherry buds and 1 percent skunkbush sumac buds.

Nutritional studies of winter sharptail foods by Evans and Dietz (1974) help explain the winter food habits observed during this study. They found that corn and Russian olive seemed to be very preferred foods, and that grouse fed the fruits of frozen western snowberry, silver buffaloberry, Russian-olive, fleshy hawthorn and corn maintained a positive or zero nitrogen balance, whereas those fed dried snowberry fruits, Wood's rose hips and plains cottonwood buds lost nitrogen. They concluded that buffaloberry was the best native food tested.

Population Size and Reproduction

The location of the 14 sharptail arenas located during this study are shown in Figure 6. The maximum counts of lekking males totaled 210 and averaged 15.0 per arena (Table 13). This is similar to the average number of males observed per arena (15.8) in Region 7 from 1963-1973 (Wallestad 1974). All of the arenas were probably not located because I was not granted access to some of the suitable upland grassland especially in the southeastern portion of the area. Some arenas were located in this area by observations from adjoining land and from an airplane. Population estimates are therefore minimal.

Using the maximum total count of males and assuming a 50:50 sex ratio (Robel, et al. 1972), a minimum population estimate would be approximately 420 grouse during that spring period. However, Rippin and Boag (1974) have presented evidence suggesting that as many as 50 percent of the males in a sharptail population may be nonterritorial. The presence of nonterritorial

Table 12. Results of sharptail feeding observations on the Intake Study Area, winter 1976-77.

Food	Including Grain		Excluding Grain	
	Feed. Obs. (689)[1]	Feed. + Probable Feed. (830)	Feed. Obs. (298)	Feed. + Probable Feed. (402)
Grain stubble	56.7[2]	51.6	-	-
Buffaloberry	8.4	11.7	19.5	24.1
Skunkbush sumac	9.9	8.2	22.8	16.9
Russian olive	7.3	6.3	16.8	12.9
Creeping juniper	6.8	5.7	15.8	11.7
Rose	3.0	3.6	7.0	7.5
Rocky Mountain juniper	1.7	3.5	4.0	7.2
Chokecherry	-	3.1	-	6.4
Common juniper	1.7	1.4	4.0	3.0
Hay yard	1.7	1.4	4.0	3.0
Plains cottonwood	0.9	1.3	2.0	2.7
Green ash	1.2	1.2	2.7	2.5
Snowberry	0.6	0.5	1.3	1.0
Willow		0.4	1.0	0.7
American elm		0.1		0.2

1 Sample size
2 Percent of observations

Table 13. Data on sharp-tailed grouse arenas located on the Intake Study Area, 1977.

Arena No.	Date Located	Maximum Count of Lekking Males	Date of Maximum Count	Location
1	9 March	13	16 March	NE¼, Sec. 9, T17N, R57E
2	15 March	26	2 April	NW¼, Sec. 13, T17N, R57E
3	15 March	21	26 April	SW¼, Sec. 24, T17N, R57E
4	16 March	13	19 March	NW¼, Sec. 4, T17N, R57E
5	19 March	9	19 March	SW¼, Sec. 5, T17N, R57E
6	1 April	11	1 April	NW¼, Sec. 13, T17N, R56E
7	6 April	18	6 April	NW¼, Sec. 29, T17N, R57E
8	13 April	7	13 April	NW¼, Sec. 12, T17N, R57E
9	14 April	18	14 April	NW¼, Sec. 19, T17N, R58E
10	12 April	19	12 April	SE¼, Sec. 26, T17N, R57E
11	16 April	12	16 April	NW¼, Sec. 35, T17N, R57E
12	26 April	14	26 April	NE¼, Sec. 36, T17N, R57E
13	5 May	14	5 May	NW¼, Sec. 3, T16N, R56E
14	8 May	4+[1] (15)	8 May	SE¼, Sec. 15, T17N, R57E

[1] This arena was located late in the day on 8 May and was not revisited. Because of the sounds of lekking males heard earlier in the season and appearance of the arena, I believe this arena was of average size. (Counts after 26 April are probably low).

males on the study area was suggested by observations of groups of 1-3 males observed lekking sporadically away from established arenas. Assuming 50 percent nonterritorial males, the population estimate would be about 840 grouse. The spring density of sharptails on the area was between 5.4 and 10.8 per mi^2, including areas not used by sharptails. In comparison, Martin (1976) found 1.6 - 3.3 sharp-tailed grouse per mi^2 in the Sarpy Basin, Montana, in 1975, which was the highest population between 1974 and 1977 (P. Martin, pers. comm.). The area apparently supported an excellent sharptail population.

Reproduction on the area was poor in 1977. Thirteen broods were located, but complete counts were only obtained from eight. Seven complete broods observed between 30 June and 26 August contained an average of 4.0 young. This is below the 1963-73 average of 6.7 young per brood for southeastern Montana (Wallestad 1974). From 30 June to 12 August, only 10.3 young per 100 adults were observed (N=118).

The early indications of very poor reproduction were substantiated by examination of the wings of hunter-killed birds. Although the total harvest was unknown, 56 sharptails killed on or adjacent to the study area consisted of 36 percent juveniles (59 juveniles:100 adults). Of a total of 87 wings from the Glendive-Wibaux-Sidney area, 38 percent were juveniles (61 juveniles:100 adults) indicating that reproduction was low throughout the area. The average productivity of sharp-tailed grouse in southeastern Montana from 1962-70 was 261 juveniles:100 adults, with a low of 167 juveniles:100 adults (Weigand 1971).

Hunter harvest on the study area was very poor on the opening weekend. An average of 5.3 hours of hunting was required for each sharptail bagged. This low success was probably due in part to the muddy conditions and wariness of the birds.

The reasons for the very low nest success may have been related to cover conditions. Cattle prices were depressed in 1976 and 1977, so many ranchers retained their cattle waiting for higher prices. This resulted in increased grazing pressure during these two summers. Additionally, drought conditions prevailed during the summer of 1977 and, in some areas, large numbers of grasshoppers were present. In concert, these factors caused the ranges to become quite overgrazed. Nesting sharptails require residual plant litter (Pepper 1972, Sisson 1976) and, although broods select areas with less cover (Sisson 1976), they require cover to escape from predators. Pepper (1972) found that, with few exceptions, native vegetation used by sharptail broods in Saskatchewan was ungrazed or lightly grazed. Also, the amount of ungrazed grass-shrub and haylands within a one-mile radius of an arena was significantly correlated with the number of summer sharptail observations. In Montana, Brown (1966) found positive relationships between the density of residual cover and both the location and size of arenas. Based on these studies, it appears that an increased loss of eggs and/or young due to poor cover conditions may have been an important factor in the low reproductive success in 1977.

RING-NECKED PHEASANT

Distribution

Pheasants were common on the study area and were found on the river bottom, in Box Elder Creek drainage and on the uplands near grainfields and hardwood draws (Figure 8). Pheasant crowing routes were censused using standard procedures (Gates 1966) in two areas (Figure 8). The riverbottom route averaged 16.2 crows heard per stop whereas the upland route averaged 5.8 crows per stop. This indicated that pheasants were much more abundant on the riverbottom.

Habitat Use

Pheasants selected a wide array of habitat types (Table 14). This was expected because they are an "edge" species and seem to prefer a mosaic of agricultural and brushy types, which occurred along the riverbottom.

Table 14. Seasonal habitat use by ring-necked pheasants on the Intake Study Area.

Habitat Type	Winter (1246)[1]	Spring (170)	Summer (44)	Fall (168)
Bottom cropland	84[2] (20.0)[3]	28 (6.7)	5 (1.2)	12 (2.9)
Sagebrush grassland	3	32 (2.0)	32 (2.0)	23 (1.4)
Hayfields	3 (2.1)	3 (2.1)	30 (21.4)	4 (2.9)
Hardwood draws	6 (1.1)	11 (2.0)	14 (2.5)	23 (4.2)
Juniper breaks				tr
Riparian	1	13 (1.9)	9 (1.3)	26 (3.9)
Rose-snowberry	tr	3 (4.3)	2 (2.9)	11 (15.7)
Upland crops	2	5		tr
Upland grassland	1	5	9	

[1] Sample size
[2] Percent of observations
[3] Habitat preference index, when no preference was found, no index was given.

In winter, bottomland grainfields accounted for the greatest observed use by pheasants (84%), although hayfields and hardwood draws were also selected. The riparian and rose-snowberry types undoubtedly received more use, but pheasants were more difficult to observe in those types.

Habitat selection was similar during the other three seasons. A complex of deciduous-sagebrush-agricultural types on the riverbottom and creek bottom seemed to be most important to them.

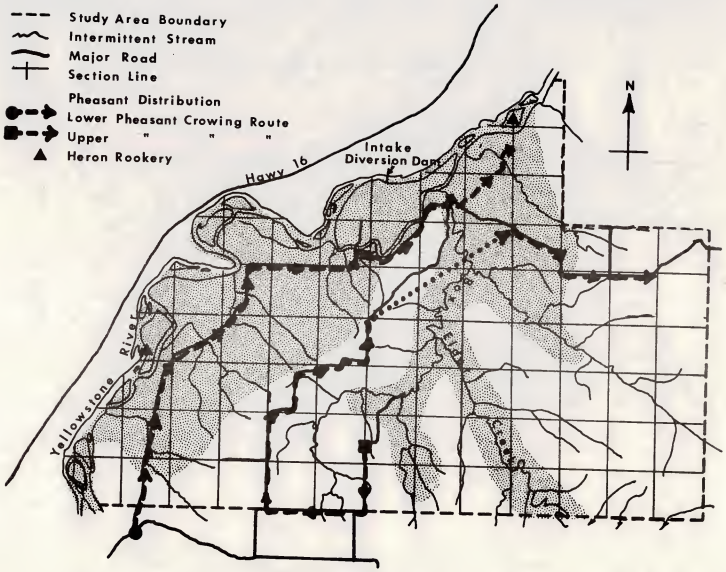

Figure 8. Distribution of the ring-necked pheasant, and location of pheasant crowing routes and heron rookeries on the Intake Study Area.

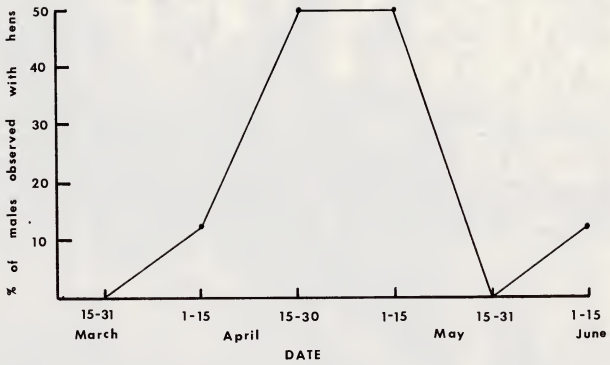

Figure 9. Pheasant harem activity, spring 1977.

Sex Ratio

Gates and Hale (1974) recommended determining pheasant sex ratios during winter, from December through February. On this study area, hens were most visible and the sex ratios were similar only in January and February. The observed ratio was 153 hens:100 cocks (N=781). This is relatively low, since pheasant sex ratios in Montana average 330 hens:100 cocks (Weigand and Janson 1976). This low hen:cock ratio suggested light hunting pressure, as the ratio nears equality in lightly hunted or unhunted areas (Weigand and Janson 1976).

Breeding Behavior

Crowing activity was found to peak between 25 April and 9 May with a high count on 9 May. The peak of crowing on the Isaac Homestead Game Management Area, Treasure County, Montana, was during this same period in 1973, 1974 and 1975 (DeSimone 1975), which supports Gates' (1966) findings that the peak of crowing in an area occurs at the same time each year.

Harem activity was also most intense in late April and early May, as indicated by the proportion of males observed with hens (Figure 9). Unfortunately, too few observations of pheasant broods were available to determine reproductive success.

CANADA GOOSE

Presence on Area

Canada geese did not winter on the study area, probably due to ice cover on the river. They were first observed on 26 February when a flock of 17 flew over the area. A few were observed in early March, but peak numbers were seen on the river during an aerial survey on 21 March (Figure 10). This is similar to the average date of peak spring migration for Canada geese in the Northern Plains area (Bellrose 1976). Hinz (in press) noted peak Canada goose numbers on the Yellowstone River occurring in March 1975 and 1976. Numbers of observations declined through April as pairs began nesting. Geese were found in small numbers during summer, but they are difficult to observe at this time (Hinz, in press). Numbers increased in late August, possibly reflecting the return of nonbreeding geese to the area from molt migrations to the north, as suggested by Hinz (in press).

Habitat Use

Canada geese preferred bottom croplands and hayfields during spring and summer and both bottom and upland croplands during fall. Excluding sightings on the river, 85 percent and 10 percent of the 78 spring

sightings were on bottom cropland and hayfields, respectively. During summer, all 131 geese not on the river were on bottom croplands. All 163 fall observations away from the river were on croplands, 65 percent on the bottom and 35 percent on the uplands.

Population Size

All (11) river islands on the study area were searched intensively for nests on 28 April. Fourteen nests and an additional five lone ganders were observed. An additional lone gander was observed repeatedly during aerial surveys and was added to the total. In all, a minimum of 22 breeding pairs was located on the study area. Fourteen clutches averaged 5.1 eggs.

An intensive study of Canada geese on the Yellowstone River between Billings and the North Dakota border was made by Hinz (in press) from September 1974 through November 1976. This permitted an evaluation of the importance of the study area in relation to the entire lower Yellowstone (Table 15). Apparently the study area was not an especially important area for Canada geese, because the number observed per km of river never exceeded the mean for the entire river. The study area was relatively most important during the fall migration period and least important during winter.

Table 15. Seasonal use by Canada geese of the Yellowstone River on the study area (Glendive-Intake) in relation to use on the entire lower Yellowstone River (Billings-Fairview) (from Hinz, in press).

	Mean number of Geese Observed km of River by Hinz		
	Entire River	Glendive-Intake	Percentage of Mean on Study Area
Winter	7	0	0
Spring migration	37	1	3
Resident period	46	10	22
Fall migration	105	58	55
Entire year	195	69	35

OTHER WATERFOWL

Nineteen species of waterfowl were observed on or adjacent to the study area (Table 18) but only Canada geese and mallards were known to have nested. Wood ducks and common mergansers may have nested there.

Mallards were the most common ducks on the area and comprised the greatest portion of the dabbling ducks observed, except perhaps during early spring migration. Few waterfowl wintered on the area, probably due to ice conditions. Numbers of diving ducks and total ducks observed on the river during aerial surveys are shown in Figure 10.

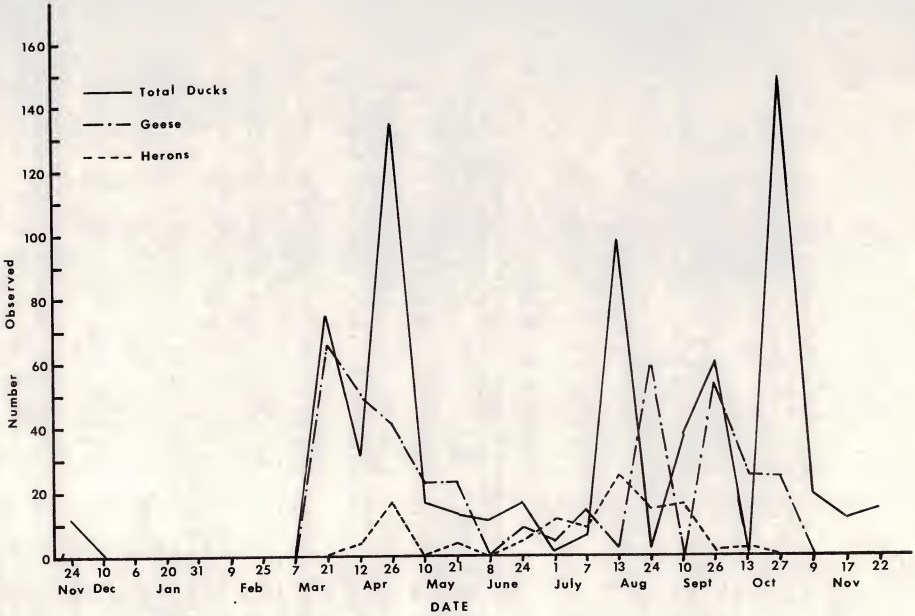

Figure 10. Waterfowl and heron use of the Yellowstone River within the Intake Study Area, based on aerial surveys.

RAPTORS

Seventeen species of raptors were observed on the study area (Table 18). One active prairie falcon nest and one ferruginous hawk nest were located on the same cliff on NE¼, Sec. 23, T17N, R57E. Both nests failed. An unoccupied nest, apparently that of a golden eagle, was located along Box Elder Creek on NE¼, Sec. 6, T17N, R57E, and an unidentified *Buteo* nest was located along the Yellowstone River on NW¼, Sec. 19, T17N, R56E. A successful great horned owl nest was found along the Yellowstone River on NW¼, Sec. 4, T17N, R56E. Other species which probably nested on the area are listed in Table 18.

The study area was used by many bald eagles during fall and spring migration. However, few bald eagles wintered on the area while the river was ice-covered.

COYOTE

Habitat Use and Movements

Seasonal habitat use by coyotes is presented in Table 16. Upland grassland was the most important type used during spring, summer and fall, but was not selected during winter. During winter, the riparian type, and associated hayfields and rose-snowberry types accounted for 58 percent of the sightings. Coyotes were dispersed over the upland types during fall, but seemed to select hardwood draws.

Although the coyote was ubiquitous on the area during all seasons, the results suggested a seasonal movement of a portion of the coyotes from the uplands to the riverbottom in winter. Observations indicated

Table 16. Seasonal habitat use by coyotes on the Intake Study Area.

	Winter (38)[1]	Spring (33)	Summer (24)	Fall (51)
Upland grassland	21[2]	61 (1.4)[3]	54 (1.3)	49 (1.1)
Upland cropland	3	6		2
Big sagebrush hillsides	3			4
Juniper breaks				4 (1.3)
Hardwood draws	3		4	18 (3.3)
Sagebrush grassland	13	15	4	8
Bottom cropland		3		
Hayfields	11 (7.9)		4 (2.9)	
Riparian	39 (5.8)	15 (2.2)	29 (4.3)	16 (2.4)
Rose-snowberry	8 (11.4)		4 (5.7)	
Group size	1.5	1.5	1.3	1.3

[1] Sample size
[2] Percent of observations
[3] Habitat preference index, where no preference was found, no index is given.

an abrupt spring movement in late March/early April and a prolonged fall movement in October and November. A coyote trapper reported an increase in catch along fencelines between the river and the uplands in early April, which substantiated these observations. The spring movement occurred just prior to the beginning of the whelping season in Montana (Hamlett 1938). Movements of a portion of coyote populations to lower areas to overwinter have been reported from Yellowstone National Park (Robinson and Cummings 1951) and California (Hawthorne 1971).

This apparent movement to the riparian areas may have been related to food availability. Coyotes apparently prefer lagomorphs (Sperry 1941, Mathwig 1973) but where they are scarce, voles become most important (Murie 1940, Hawthorne 1972) and are apparently selected over deer mice (Murie 1940). Carrion reaches its greatest importance during the winter (Murie 1940, Sperry 1941, Hawthorne 1972). The jackrabbit and cottontail rabbit populations were at a low during this study and only 7 percent of the cottontails observed during winter were on upland grasslands. Sagebrush grasslands, hardwood draws and the riparian type accounted for 72 percent of the winter cottontail observations. Mouse populations on upland grassland, which were dominated by deer mice, were much lower in the winter/early spring (0.4/100 trapnights) than in the late summer/early fall (5.4/100 trapnights). This may indicate a relative shortage of winter food on the uplands during this study. Cattle wintering on the riverbottom and the dense whitetail population there probably provided a more concentrated source of carrion than could be obtained on the uplands. Winter coyote numbers have been positively correlated with availability of carrion in Alberta (Todd and Keith 1976).

At least 30 coyotes were trapped or shot on the study area during the winter of 1976-77, and they were the most important furbearing animal. The minimum harvest of other furbearers was: 13 raccoons, 8 skunks and 4 bobcats.

Coyotes seemed to be more common in relation to mule deer in this area in 1977 than in Sarpy Creek, Montana, in 1975 and 1976 (Table 17). The results may not be completely comparable, however, because coyotes were ubiquitous on this area, and mule deer were not. Also, a sizable whitetail population was present on this area, but not on the Sarpy Creek area, resulting in a lower coyote:100 deer ratio on the Intake area.

No red foxes (*Vulpes vulpes*) were observed or reported on the study area during this study, although they were seen in agricultural areas to the east and northeast. Landowners reported that foxes were formerly common but none had seen any in the year prior to the beginning of the study. The decline in foxes reportedly occurred while the coyotes were increasing. This could be a causal relationship (Hoffmann et al. 1969).

BEAVER

A relatively high population of beavers was present on the study area. Peter Martin (pers. comm.) counted 30 caches in the Yellowstone River within the study area in 1975 and 29 in 1976. I counted 29 caches in the river in 1977. Three beaver colonies were present on Box Elder Creek and its tributaries in 1976 and 1977. The minimum total population on the area was 32 colonies in 1976 and 1977. The 1977 colony locations are shown in Figure 5.

OTHER SPECIES OF INTEREST

Pelicans were present at Intake between 1 April and 1 July. The greatest numbers were present in May and were probably nonbreeders or unsuccessful breeders.

Great blue herons were present from 12 April through 13 October (Figure 10). Seventeen active nests in two rookeries (Figure 8) were observed on the area. Herons foraged principally in the Yellowstone River, but also visited the reservoirs and beaver dams within the study area.

NONGAME

One hundred forty-one species of birds were observed on or immediately adjacent to the study area. Data on status, relative abundance and observation dates are presented in Table 18. Habitat use was determined seasonally by incidental observations and regular visits to the various habitat types and by a systematic survey in June patterned after the Breeding Bird Survey (Robbins and Van Velzen 1967). The former method is obviously vulnerable to bias due to non-random sampling. In an effort to evaluate its validity, the number of species selecting each type based on the random summer observations and considering only species with 20 or more sightings was compared with the number of species with a frequency of 30 percent or greater for the corresponding habitat type, based on the systematic survey. The results were significantly correlated ($r=0.8977$), indicating the two methods gave comparable information about species diversity in each habitat type. This added confidence to the results for other seasons, which were based on non-systematic surveys.

Seasonal habitat use, as determined by non-systematic observations, is presented in Appendices 1, 2, 3 and 4 and results of the breeding bird survey are presented in Appendix 5.

Thirty-two species of mammals were observed on the study area (Table 19). Red foxes were observed and reported north of the river. Data on habitat use of larger nongame mammals were collected as for birds and are presented in Appendices 6, 7, and 8.

Table 18. Birds observed on or immediately adjacent to the Intake study area, 23 November 1976 - 22 November 1977.

Species	Scientific Name	Status & Abundance[1]	Date Observed
Common loon	*Gavia immer*	fm-R	26 Sept.
Eared grebe	*Podiceps nigricollis*	sm-U,fm-U,s-R	27 Apr-13 Sept.
Western grebe	*Aechmophorus occidentalis*	fm-R	22 Aug-14 Oct
Pied-billed grebe	*Podilymbus podiceps*	sm-R,fm-R	18 May-11 June, 30 Aug.
White pelican	*Pelecanus erythrorhynchos*	sm-C,s-A	12 Apr-1 July
Double-crested cormorant	*Phalacrocorax auritus*	sm-R	12-28 Apr.
Great blue heron	*Ardea herodias*	B-C	12 Apr-13 Oct.
Whistling swan	*Olor columbianus*	sm-R	2 Apr 1975-T.H.[3]
Canada goose	*Branta canadensis*	B-C,w-R	12 Feb-19 Nov
Snow goose	*Chen caerulescens*	fm-R	16 Nov 1976-T.H.
Mallard	*Anas platyrhynchos*	B-U,w-R	24 Nov-3 Dec. 21 Mar-22 Nov
Gadwall	*A. strepera*	fm-R	27 Oct
Pintail	*A. acuta*	sm-C	14 Mar-28 Apr
Green-winged teal	*A. crecca*	sm-U,fm-U	28 Mar-18 May,12 Aug-10 Sept.
Blue-winged teal	*A. discors*	sm-C,fm-U	28 Mar-18 May, 30 Aug-26 Sept.
American widgeon	*A. americana*	sm-U,fm-U	28 Mar-28 Apr., 30 Aug-14 Oct.
Northern shoveler	*A. clypeata*	sm-R	28 Mar-31 May
Wood duck	*Aix sponsa*	sm-R (b?)	28 Apr
Redhead	*Aythya americana*	fm-R	14 Oct
Canvasback	*A. valisineria*	sm-R	12 Apr
Lesser scaup	*A. affinis*	fm-R	10 Sept
Common goldeneye	*Bucephala clangula*	w-R,sm-R	3 Dec - 26 Apr
Bufflehead	*B. albeola*	sm-R,fm-R	18 May, 27 Oct
Ruddy duck	*Oxyura jamaicensis*	sm-R	17-30 May
Hooded merganser	*Lophodytes cucullatus*	sm-R	16 Apr
Common merganser	*Mergus merganser*	w-U,sm-U,s-R (b/)	24 Nov-28 Apr, 7 July
Turkey vulture	*Cathartes aura*	b-U	15 Apr-20 Sept
Sharp-shinned hawk	*Accipiter striatus*	b-R	19 May-13 Sept
Cooper's hawk	*A. cooperii*	s-R,w-R	23 June, 18 Nov
Red-tailed hawk	*Buteo jamaicensis*	w-R,b-U	EY[5](winter=23 Dec,12 Feb)
Swainson's hawk	*B. swainsoni*	b-R	22 June-22 Sept.
Rough-legged hawk	*B. lagopus*	w-R	24 Nov-28 Mar
Ferruginous hawk	*B. regalis*	B-R	12 May-19 June
Golden eagle	*Aquila chrysaetos*	W-U,b-R	EY
Bald eagle	*Haliaeetus leucocephalus*	W-U	15 Oct-6 Apr.

Table 18 continued

Species	Scientific Name	Status & Abundance[1]	Dates Observed
Marsh hawk	*Circus syaneus*	b-U	17 Mar-13 Oct
Osprey	*Pandion haliaetus*	s-R	8 June 1976-T.H.
Prairie falcon	*Falco mexicanus*	B-R,W-U	EY
Merlin	*F. columbarius*	sm-R,fm-R	28 Mar-9 May,30 Aug-19 Oct
American kestril	*F. sparverius*	b-C	14 Mar-14 Oct
Sharp-tailed grouse	*Pediocecetes phasianellus*	B-C,W-C	EY
Ring-necked pheasant	*Phasianus colchicus*	B-C,W-C	EY
Gray partridge	*Perdix perdix*	b-U,W-U	EY
Sandhill crane	*Grus canadensis*	sm-R,fm-U	12-29 Apr, 12 Oct-4 Nov
American coot	*Fulica americana*	sm-R	26 Apr-11 June
Killdeer	*Charadrius vociferus*	B-C	17 Mar-23 Sept.
Common snipe	*Capella gallinago*	fm-R	31 Aug-26 Sept.
Long-billed curlew	*Numenius americanus*	b-U	28 Apr-1 Sept
Upland sandpiper	*Bartramia longicauda*	b-U	12 May-5 July
Solitary sandpiper	*Tringa solitaria*	sm-R,fm-R	18 May, 13 Sept.
Willet	*Catoptrophorus semipalmatus*	sm-R	28 Apr
Greater yellowlegs	*Tringa melanoleuca*	sm-R,fm-R	28 Apr, 12 Oct
Long-billed dowitcher	*Limnodromus scolopaceus*	sm-R	28 Apr
American avocet	*Recurvirostra americana*	sm-R,fm-R	26 Apr-18 May, 10 Sept.
Wilson's phalarope	*Steganopus tricolor*	sm-R	17 May
Ring-billed gull	*Larus delawarensis*	sm-R,fm-R	28 Mar-26 Apr, 27 Oct-9 Nov.
Franklin's gull	*L. pipixcan*	sm-R,fm-R	28 Apr-7 May, 27 Oct.
Rock dove (feral)	*Columba livia*	b-R	5 Arp-17 Nov
Mourning dove	*Zenaidura macroura*	B-A	12 Apr-13 Oct
Black-billed cuckoo	*Coccyzus erythropthalmus*	b-U	3 June-5 July
Screech owl	*Otus asio*	w-R,s-R	17 Jan, 10 Sept
Great horned owl	*Bubo virginianus*	B-U,W-U	EY
Snowy owl [4]	*Nyctea scandiaca*	w-R	Nov or Dec
Burrowing owl	*Speotyto cunicularia*	fm-R	10-21 Sept
Common nighthawk	*Chordeiles minor*	b-C	4 June-31 Aug
Belted kingfisher	*Megaceryle alcyon*	b-R	30 Apr-21 Sept
Common flicker	*Colaptes auritus*	b-C	24 Mar-9 Nov
Red-headed woodpecker	*Melanerpes erythrocephalus*	B-U	12 May-30 Aug
Hairy woodpecker	*Dendrocopos villosus*	W-U,b-U	EY
Downy woodpecker	*D. pubescens*	W-U	12 Sept-7 Apr
Eastern kingbird	*Tyrannus tyrannus*	B-C	17 May-31 Aug
Western kingbird	*T. verticalis*	b-C	12 May-12 Sept
Say's phoebe	*Sayornis saya*	b-U	16 Apr-12 Sept

Table 18 continued

Species	Scientific Name	Status & Abundance	Dates Observed
Least flycatcher	*Empidonaxminimus*	b-U	3 June-30 Aug
Western wood pewee	*Contopus sordidulus*	b-U	3 June-26 Aug
Horned lark	*Eremophila alpestris*	b-C,W-A	EY
Tree swallow	*Iridoprocne bicolor*	sm-R	3 June
Bank swallow	*Riparia riparia*	s-R	4 May
Rough-winged swallow	*Stelgidopteryx ruficollis*	b-R	12-23 May
Barn swallow	*Hirundo rustica*	B-U	13 May-12 Sept
Cliff swallow	*Petrochelidon pyrrhonota*	B-U	13 May-?
Blue jay	*Cyanocitta cristata*	sm-R,fm-R	18 May, 15 Aug-27 Oct
Black-billed magpie	*Pica pica*	B-C,W-C	EY
Common crow	*Corvus brachyrhynchos*	B-C,fm-A	14 Mar-13 Oct
Black-capped chickadee	*Parus atricapillus*	b-U,W-C	EY
White-breasted nuthatch	*Sitta carolinensis*	W-U,s(b?)-R	11 July-24 Mar
House wren	*Troglodytes aedon*	b-C	17 May-1 Sept
Rock wren	*Salpinctes obsoletus*	b-C	15 Apr-12 Sept
Gray catbird	*Dumetella carolinensis*	b-U	6 May-20 Sept
Brown thrasher	*Toxostoma rufum*	B-C	7 May-26 Aug
Robin	*Turdus migratorius*	B-C,w-R	7-15 Dec, 17 Mar-9 Nov
Mountain bluebird	*Sialia currucoides*	b-U	24 Mar-12 Oct
Townsend's solitaire	*Myadestes townsendi*	W-U	14 Oct-2 Feb
Water pipit	*Motacilla spinoletta*	sm-R	28 Arp
Bohemian waxwing	*Bombycilla garrulus*	W-C	1 Dec-22 Mar
Cedar waxwing	*B. cedrorum*	fm-U	13 Sept-27 Oct
Northern shrike	*Lanius excubitor*	W-U	13 Oct-8 Mar
Loggerhead shrike	*L. ludovicianus*	B-U	7 Apr-31 Aug
Starling	*Sturnus vulgaris*	b-C	24 Mar-21 Oct
Red-eyed vireo	*Vireo olivaceus*	b-U	3 June-13 Sept
Black-and-white warbler	*Mniotilta varia*	sm-R	11 June
Yellow warbler	*Dendroica petechia*	b-C	9 May-10 Sept
Magnolia warbler	*D. magnolia*	fm-R	22 Sept
Yellow-rumped warbler	*D. coronata*	fm-U	12-13 Sept
MacGillivray's warbler	*Oporornis tolmiei*	fm-U	12-22 Sept
Common yellowthroat	*Geothlypis trichas*	b-C	18 May-12 Sept
Yellow-breasted chat	*Icteria virens*	b-C	18 May-15 Aug
Wilson's warbler	*Wilsonia pusilla*	sm-R	28 Apr
American redstart	*Setophaga ruticilla*	b-U	3 June-31 Aug

Table 18 continued

Species	Scientific Name	Status & Abundance	Dates Observed
House sparrow	*Passer domesticus*	b-U,W-U	EY
Bobolink	*Dolichonyx oryzivorus*	b-R	4-23 June
Western meadowlark	*Sturnella neglecta*	B-A	17 Mar-24 Oct
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	sm-R,s-R,fm-R	27 Apr-23 Sept
Red-winged blackbird	*Agelaius phoeniceus*	B-C	24 Mar-12 Oct
Orchard oriole	*I. spurius*	b-R	10-29 June
Northern oriole	*Icterus galbula*	b-U	19 May-15 Aug
Common grackle	*Quiscalus quiscula*	b-C,w-R	12 Apr-6 July, 11 Feb
Brewer's blackbird	*Euphagus cyanocephalus*	B-C	27 Apr-17 Oct
Brown-headed cowbird	*Molothrus ater*	b-C	17 May-15 Aug
Indigo bunting	*Passerina cyanea*	s-R	27 June
Lazuli bunting	*P. amoena*	b-U	25 May-6 July
Evening grosbeak	*Hesperiphona vespertina*	m-R	9 Nov
Gray-crowned rosy finch	*Leucosticte tephrocotis*	W-U	27 Oct-24 Feb
Common redpoll	*Acanthis flammea*	w-U	9 Nov-10 Jan
American goldfinch	*Spinus tristis*	b-C	6 May-14 Oct
Rufous-sided towee	*Pipilo erythrophthalmus*	B-C	5 May-26 Sept
Lark bunting	*Calamospiza melanocorys*	b-U	8 May-5 July
Grasshopper sparrow	*Ammodramus savannarum*	b-U	8 May-5 July
Vesper sparrow	*Pooecetes gramineus*	b-C	14 Apr-29 Sept
Lark sparrow	*Chondestes grammacus*	b-C	6 May-13 Sept
Dark-eyed junco	*Junco nyemalis*	sm-U,fm-U	24 Mar-4 May, 13-19 Oct
Tree sparrow	*Spizella arborea*	w-C,sm-A	14 Oct-7 Apr
Chipping sparrow	*S. passerina*	b-U	5 May-21 Sept
Clay-colored sparrow	*S. pallida*	s-R	3 June
Field sparrow	*S. pusilla*	B-C	5 May-21 Oct
Harris' sparrow	*Zonotrichia querula*	fm-U	17-21 Oct
White-crowned sparrow	*Z. leucophrys*	sm-R,fm-R	28 Apr, 14 Sept
Song sparrow	*Melospiza melodia*	b-R	7 Apr-12 Sept
Lapland longspur	*Calcarius lapponicus*	W-A	12 Oct-9 Mar
Chestnut-collared longspur	*C. ornatus*	fm-R	12-21 Sept
Snow bunting	*Plectrophenax nivalis*	W-C	20 Oct-9 Feb

Table 18 continued.

[1]A (abundant): found in large numbers in appropriate habitats
C (common): found in moderate numbers in appropriate habitats
U (uncommon): present in appropriate habitats, but in small numbers
R (rare):few sightings
W: overwinters on area (at least one record for each winter month)
w: transient in winter
fm: fall migrant
sm: spring migrant
B: breeds on area (nest or dependent young located)
b: probably breeds on area (territorial males or pairs located)
s: summers on area in small numbers, but no evidence of breeding
[2] Sighted from an aircraft, species determination uncertain
[3] Observed by Thomas Hinz during aerial surveys of the Yellowstone River
[4] Sighted by mailman, unconfirmed.
[5] EY: present entire year

Table 19. Mammalian species observed on the Intake Study Area.

Species	Scientific Name	Abundance
Common Shrew	*Sorex cinereus*	U
Hoary bat	*Lasiurus cinereus*	U
Big brown bat	*Eptesicus fuscus*	C
Long-legged myotis	*Myotis volans*	U
Small-footed myotis	*Myotis leibii*	U
Little-brown myotis	*Myotis lucifugus*	C
White-tailed jackrabbit	*Lepus townsendii*	U
Desert cottontail	*Sylvilagus audubonii*	U
Porcupine	*Erethizon dorsatum*	U-C
Beaver	*Castor canadensis*	C
Northern pocket gopher	*Thomomys talpoides*	C
Ord's kangaroo rat	*Dipodomys ordii*	U
Olive-backed pocket mouse	*Perognathus fasciatus*	U
Least chipmunk	*Eutamias minimus*	R
Thirteen-lined ground squirrel	*Spermophelis tridecemlineatus*	R
Eastern fox squirrel	*Sciurus niger*	U-R
House mouse	*Mus musculus*	R
Bushy-tailed woodrat	*Neotoma cinerea*	R
Western harvest mouse	*Reithrodontomys megalotis*	U
Deer mouse	*Peromyscus maniculatus*	A
White-footed mouse	*Peromyscus leucopus*	
Prairie vole	*Microtus ochrogaster*	U
Bobcat	*Lynx rufus*	U
Raccoon	*Procyon lotor*	C
Coyote	*Canis latrans*	C
Striped skunk	*Mephitis mephitis*	C
Badger	*Taxidea taxus*	U
Mink	*Mustela vison*	
Long-tailed weasel	*Mustela frenata*	
Pronghorn antelope	*Antilocapra americana*	U
White-tailed deer	*Odocoileus virginianus*	A
Mule deer	*Odocoileus hemionus*	C

[1] Abbreviations explained in Table 18.

A total of 4,200 trapnights of trapping effort was expended in the 10 habitat types to sample small mammal populations. Trapping was done primarily during two periods, between 6 December - 4 April (2,640 trapnights) and 21 September - 19 October (1,560 trapnights). No mammals were captured during 360 trapnights during July, so summer trapping was discontinued and the results were disregarded. The results from the winter-spring and fall periods were combined because similar habitat use was found during both periods. Seven species were trapped (Table 20). Deer mice and white-footed mice were recorded on the area, but they were extremely difficult to differentiate in the field and the two species were lumped under *Peromyscus*. Deer mice were more common than white-footed mice, which were probably restricted primarily to the riverbottom (Hoffmann et al. 1969a). The two verified specimens of the white-footed mouse were captured in the rose-snowberry type on the river bottom.

The characteristic nongame animals and relative faunal diversity and productivity of each habitat type are discussed:

Riparian Type: This type was very important for many bird species on the study area as indicated by the high proportion of the birds species present that selected this type during each season. During the breeding bird surveys, it yielded the highest average number of species per stop (11.8) and second highest number of individuals per stop (18.5). The diversity was found to be high, and the community dominance index was low; the two most dominant species were mourning dove and house wren (Table 21). The cottonwood forest vegetation type supported the largest number and greatest variety of species of four habitat types studied along the Missouri River in north-central Montana (Walcheck 1970). The breeding birds present in this habitat type were similar to those reported by Walcheck (1970) for the cottonwood forest type and by Steward (1975) for the western river floodplain forest type in North Dakota. The high diversity of breeding birds in this type was probably related to the high foliage height profile (MacArthur and MacArthur 1961).

Characteristic birds observed in this type included the following: Winter birds: bald eagle, great horned owl, hairy woodpecker, black-billed magpie, black-capped chickadee, white-breasted nuthatch, Bohemian waxwing and tree sparrow. Migrants: bald eagle, Wilson's warbler, red-winged blackbird, and dark-eyed junco. Breeding birds: (including birds which foraged in this type but did not breed there) great blue heron, turkey vulture, red-tailed hawk, American kestrel, killdeer (riverbank), black-billed cuckoo, mourning dove, great horned owl, common nighthawk, common flicker, red-headed woodpecker, downy woodpecker, eastern kingbird, western wood pewee, black-billed magpie, common crow, black-capped chickadee, white-breasted nuthatch, house wren, gray catbird, brown thrasher, robin, yellow-breasted chat, lazuli bunting, American goldfinch, rufous-sided towee, lark sparrow, chipping sparrow and field sparrow.

Table 20. Comparison of small mammal densities as determined by snap trapping, in 10 habitat types on the Intake Study Area.

Species	Bottom Crops	Sagebrush Grassland	Hayfields	Xeric Hillsides	Hardwood Draws	Juniper Breaks	Riparian	Rose-Snowberry	Upland Crops		
									Edge	Infield	Grassland
Sample size (trapnights)	240	480	360	360	480	360	360	240	360	240	720
Common shrew								1.3[1]		0.8	
Olive-backed pocket mouse	0.8								0.6		
Thirteen-lined ground squirrel			0.3								
House mouse	0.4	0.2					0.3			0.4	
Western-harvest mouse	1.7	0.4	0.6						3.0		
Peromyscus spp.[2]	2.5	3.6	0.8	6.4	1.6	2.5	1.4	5.4	0.8		2.1
Prairie vole	1.2							2.1	1.0		
	6.6	4.2	1.7	6.4	1.6	2.5	1.7	8.8	6.7	1.2	2.1

[1] Number of animals per 100 trapnights.

[2] Includes *Peromyscus maniculatus* and *P. leucopus*.

Table 21. Results of the breeding bird survey on the Intake Study Area.

Category	HABITAT TYPE									
	Bottom Croplands	Sagebrush Grassland	Hayfields	Xeric Hillsides	Hardwood Draws	Juniper Breaks	Riparian	Rose-Snowberry	Upland Crops	Upland Grassland
No. of counts	7	12	9	13	18	16	11	5	18	30
Mean species/stop	5.0	6.2	5.7	2.4	8.9	4.5	11.8	3.4	5.5	5.8
Mean birds/stop	15.1	13.4	12.2	3.0	13.1	7.2	18.5	5.6	21.6	13.8
Total no. species	12	23	17	11	31	19	35	5	18	26
Diversity index	2.34	3.38	3.03	2.99	4.53	3.41	4.51	2.17	2.51	3.19
Community dominance index	0.72	0.47	0.53	0.44	0.16	0.40	0.23	0.57	0.70	0.58

The riparian type was not as important for small mammals as for birds in terms of species diversity or numbers of individuals perhaps due to sparse understory vegetation. This type tied with hayfields for 8th and 9th rank in small mammals/100 trapnights and only *Peromyscus* spp. and house mice were trapped (Table 20). Both species of *Peromyscus* were present. *Peromyscus leucopus* is apparently only found in the Yellowstone and Big Horn River Valleys in Montana (Hoffman et al. 1969a). Whitaker (1967) found that the white-footed mouse apparently requires more cover and more stable conditions than the deer mouse and that the former is probably more common in woodlands.

Seventeen bats were collected using a mist net and a shotgun at ponds in the riparian type between 1 July and 31 August. The following species were collected: big brown bat (6), hoary bat (2), little brown myotis (7), and long-legged myotis (2). One small-footed myotis was collected in the Glendive Post Office so it probably occurs on the study area. The first three species are widespread in Montana (Hoffmann and Pattie 1968). The long-legged bat had not previously been recorded from this part of Montana (Hoffman, et al. 1969) but Jones and Genoways (1966) collected one at Medora, North Dakota, 55 miles east-southeast from the study area. The study area is on the edge of the range of the small-footed bat in Montana (Swenson 1969).

Characteristic medium-sized mammals observed in the riparian type include: desert cottontail, porcupine, eastern fox squirrel, raccoon, striped skunk, and bobcat.

Rose-snowberry type: This valley-floor type showed the opposite trend as the above type: a low proportion of bird species present selected it throughout the year, it ranked 9th in both species and individuals per stop during the breeding bird survey, and the diversity index was the lowest recorded. The two major species, common yellow-throat and field sparrow, exhibited a moderate community dominance. However, the small mammal catch was the highest of all types and yielded common shrew, both *Peromyscus* species and prairie vole. The thick shrub cover may have provided excellent cover for small mammals.

Characteristic birds included: wintering birds: tree sparrow, migrants: dark-eyed junco, chipping sparrow, Harris' sparrow, breeding birds: common yellow-throat, yellow-breasted chat, rufous-sided towee, and field sparrow.

Desert cottontails and striped skunks were the only medium-sized mammals observed using this type.

Hardwood draw type: This habitat type was structurally similar to the riparian type and use by animals was correspondingly similar although the species differed somewhat. A relatively high proportion of bird species selected this type throughout the year, although levels of use were below those for the riparian type. The breeding bird survey

revealed that hardwood draws ranked second in species/stop and sixth in individuals/stop. The diversity index was similar to the riparian type and the community dominance index was the lowest recorded. Three species tied for dominance: yellow warbler, rufous-sided towee and mourning dove. The characteristic birds of this type are similar to those listed by Stewart (1975) for the western upland deciduous forest type in North Dakota. They are winter birds: hairy woodpecker, black-billed magpie, black-capped chickadee, white-breasted nuthatch, Bohemian waxwing, and tree sparrow; migrants: common snipe, cedar waxwing, yellow-rumped warbler, MacGillivray's warbler, evening grosbeak, chipping sparrow, song sparrow; breeding birds: black-billed cuckoo, mourning dove, great horned owl, common flicker, red-headed woodpecker, western wood pewee, black-billed magpie, common crow, black-capped chickadee, house wren, brown thrasher, robin, yellow warbler, common yellowthroat, yellow-breasted chat, common grackle, luzuli bunting, American goldfinch, rufous-sided towee, chipping sparrow and field sparrow. One migrant, a magnolia warbler, observed in this type was the seventh record for the state.

The hardwood draw type was not important for small mammals; only *Peromyscus* spp. was trapped, and the catch was the lowest recorded during this study (Table 20). The understory of the hardwood draws was similar to that of the riparian type.

Characteristic medium-sized mammals observed using this type included: desert cottontail, porcupine, eastern fox squirrel, bobcat, raccoon and striped skunk. Bushy-tailed woodrats were present in abandoned buildings in this type.

Juniper breaks type: The juniper breaks type was selected by a lower number of bird species than the other timbered types. Relatively more species of those present selected it during the winter and fewer during the fall. According to the breeding bird survey, this type ranked eighth in both species/stop and individuals/stop. The diversity and community dominance indices were average, compared with the other types (Table 21). Rufous-sided towees and field sparrows were the most common breeding birds. The lower diversity and numbers of birds in this habitat as compared with the other timbered types may be related to a less complex vegetative structure (MacArthur and MacArthur 1961). The juniper type is more xeric than the other timbered types, suggesting a lower productivity. Although this may also have affected the avian community structure, Willson (1974) reported no correlation between avian abundance or biomass and annual productivity of the habitat. The breeding birds were in many respects different from those reported by Stewart (1975) for the western evergreen forest in North Dakota, probably because he lumped juniper stands with pure ponderosa pine. The results of this study are more similar to Walcheck's (1970) results from a limber pine-juniper woodland type in the Missouri Breaks. No pine trees were present on the Intake area.

Characteristic birds included: winter birds: black-billed magpie, black-capped chickadee, townsend's solitaire, and Bohemian waxwing; migrants: golden eagle, black-and-white warbler, gray-crowned rosy finch, dark-eyed junco; breeding birds: American kestrel, mourning dove, common flicker, Say's phoebe, black-billed magpie, black-capped chickadee, rock wren, brown thrasher, mountain bluebird, loggerhead shrike, rufous-sided towee, lark sparrow, chipping sparrow and field sparrow. Few species were characteristic of juniper breaks in the winter, but Townsend's solitaires feed almost exclusively on juniper berries (Lederer 1977) and Bohemian waxwings were observed feeding primarily on juniper berries, indicating that the junipers were of paramount importance to these two species.

Only *Peromyscus* sp. was trapped in juniper breaks, but the catch was higher than for the other timbered types, perhaps due to the growth form of Rocky Mountain juniper and creeping juniper, which would provide more cover to small terrestrial animals.

Desert cottontail, porcupine and bobcat were the other mammals characteristic of this type.

Xeric hillsides type: Overall, fewer avian species selected this habitat type than any other, and it ranked last in both species/stop and individuals/species in the breeding bird survey. The diversity index was low, next to rose-snowberry and the community dominance was moderate (Table 21). Western meadowlark and rock wren were the two most common summer species. This type was very exposed and xeric, probably resulting in the harshest microclimate on the study area. The avifauna of this habitat type was poorer than that reported by Stewart (1975) for the badlands community complex in North Dakota, probably because his habitat type embraced more than just the xeric hillside type. Characteristic birds included: winter birds: gray-crowned rosy finch; breeding birds: rock dove, mourning dove, turkey vulture, Say's phoebe, rock wren, western meadowlark, and field sparrow. The gray-crowned rosy finches were observed feeding on the seedheads of grasses on the steep slopes where cattle had not grazed.

Only *Peromyscus* sp. was captured during snap-trapping in this type, but the catch was high (Table 20). Some use by desert cottontails (not selection) was noted.

Upland grassland: This habitat type accounted for a rather stable, but low proportion of use by the birds on the area throughout the year. The breeding bird survey revealed that this habitat type ranked fourth in both species/stop and individuals/stop. The diversity index was rather low and the community dominance index rather high (Table 21). Mourning doves and western meadowlarks were the dominant species. The grass was very short in 1977, due to drought and overgrazing. Cody (1968) determined that vegetation height could be used to predict the number of avian species present on a grassland and Wiens and Dyer

(1975) reported that heavy grazing generally reduced species numbers. Interestingly, the parameters of individuals and species per stop and diversity index were similar for upland grassland, hayfields (which were mowed twice) and sagebrush grassland. The latter type had the greatest diversity and species/stop, probably due to inclusion of sagebrush, which increased the habitat's complexity. The characteristic birds were similar to those listed by Stewart (1975) for the western mixed-grass prairie in North Dakota, and include: winter birds: gray partridge, common redpoll; migrants: merlin, western kingbird, gray-crowned rosy finch, chipping sparrow and lapland longspur; breeding birds: marsh hawk, prairie falcon, gray partridge, mourning dove, horned lark, loggerhead shrike, western meadowlark, Brewer's blackbird, American goldfinch, lark bunting, grasshopper sparrow and vesper sparrow.

Only *Peromyscus* sp. (probably deer mouse) was captured while snap-trapping and this type ranked seventh in small mammal abundance (Table 20). Ord's kangaroo rats were trapped in sandy areas within this type. White-tailed jackrabbits and striped skunks were other characteristic mammals.

Sagebrush Grassland: This type was selected by a rather low proportion of the bird species present in winter and a rather high proportion in the other seasons. Results of the breeding bird survey (Table 21) showed a rather high diversity, highest of the non-timbered types, and a moderate community dominance index. This type ranked third in species/stop and fifth in birds/stop. The most common breeding birds were western meadowlarks and mourning doves. The breeding birds in this type differed from those in Walcheck's (1970) similar sagebrush grassland type on the Missouri River. He found Brewer's sparrows (*Spizella breweri*) to be the most common species and did not report field sparrows. I did not observe Brewer's sparrows, but found field sparrows to be rather common. Characteristic birds included: winter birds: golden eagle, great horned owl, northern shrike, migrants: red-tailed hawk, mountain bluebird, loggerhead shrike, dark-eyed junco, tree sparrow; breeding birds: turkey vulture, marsh hawk, American kestrel, killdeer, upland sandpiper, mourning dove, great horned owl, common nighthawk, common flicker, eastern kingbird, western kingbird, horned lark, western meadowlark, red-winged blackbird, common grackle, rufous-sided towee, lark sparrow, and field sparrow.

Peromyscus sp. (probably all deer mice) and western harvest mice were the only small mammals trapped in this habitat type. Mouse abundance was moderate, compared with the other types (Table 20). Characteristic larger mammals included white-tailed jackrabbits and desert cottontails.

Hayfields: Hayfields were selected by a moderate proportion of the bird species present in spring and summer, when the fields were irrigated, but were relatively unimportant during fall and winter. The type ranked fifth in species/stop and seventh in birds/stop during the breeding bird

survey. The diversity index was moderate and the community dominance index was rather high (Table 21). Dominating species were the western meadowlark and red-winged blackbird. Characteristic birds included: winter birds: bald eagle, prairie falcon; migrants: Canada goose, mallard, blue-winged teal, rock dove, common crow, yellow-headed blackbird, lark sparrow, dark-eyed junco, field sparrow; breeding birds: marsh hawk, American kestrel, mourning dove, great horned owl, common nighthawk, common flicker, eastern kingbird, western kingbird, barn swallow, robin, starling, red-winged blackbird, common grackle and Brewer's blackbird.

Hayfields had a low density of small mammals. Three species were recorded: thirteen-lined ground squirrel, western harvest mouse and *Peromyscus* sp. Larger mammals characteristic of this type were white-tailed jackrabbit, desert cottontail, and striped skunk.

Upland Crops: A high proportion of the birds present in winter selected this type. This proportion decreased through summer and increased to the spring level in fall. Results of the breeding bird survey showed that upland crops ranked first in birds/stop and sixth in species/stop. The diversity index was rather low, but the community dominance index was high with mourning doves and western meadowlarks as the dominant species. The results of this study were different from Owens and Myre's (1973) results in Alberta. They found a similar number of birds per stop and total number of species on a route through native fescue grassland and one through cultivated land. However, they studied only passerines. They found that the grasslands along fence rows and barrow pits provided a significant portion of habitat available where agriculture was widespread. Many of the species recorded on croplands during the breeding season in this study did not breed there, but only foraged there; e.g., mallard, mourning dove, American kestrel, common crows, et. Owens and Myres (1973) reported that the horned lark was the only native grassland passerine able to nest on cultivated lands.

Characteristic breeding birds of the upland croplands were similar to the breeding birds listed by Stewart (1975) for cropland in North Dakota and included: winter birds: prairie falcon, horned lark, gray-crowned rosy finch, common redpoll, tree sparrow, Lapland longspur, snow bunting; migrants: Canada goose, northern shoveler, sandhill crane, eastern kingbird, western kingbird, common crow, vesper sparrow, chipping sparrow; breeding birds: mallard, marsh hawk, American kestrel, upland sandpiper, mourning dove, horned lark, common crow, loggerhead shrike, bobolink, western meadowlark, red-winged black-bird, American goldfinch, and lark bunting.

The edges of upland crops were apparently a good habitat for small mammals. Four species were present and the density was relatively high. The species were the olive-backed pocket mouse, western harvest mouse, *Peromyscus* sp. and prairie vole. Only two species (pocket mouse and harvest mouse) were recorded 20 m from the edge in wheat stubble (Table 20). Prairie voles were trapped only at the edges of croplands

and in the rose-snowberry type. These types were protected from grazing which resulted in good grass cover. Maxwell and Brown (1968) found this species to be most common in eastern Wyoming in sage-grass communities with high vegetation and little bare soil. Western harvest mice and olive-backed pocket mice are granivorous, which explains their abundance in croplands.

White-tailed jackrabbits and raccoons regularily frequented upland crops.

Bottomland Crops: Although some different species used bottomland crops, other avian and mammalian parameters were similar to upland crops. The results of the breeding bird survey showed that this type ranked third in birds/stop and seventh in species/stop. Fewer bird species were observed on bottomland crops compared with upland crops, the diversity index was less and the community dominance index was similar. Mourning doves and western meadowlarks dominated.

Characteristic bird species in this type included: winter birds: golden eagle, prairie falcon, gray partridge, great horned owl, horned lark, northern shrike, tree sparrow and Lapland longspur; migrants: red-tailed hawk, sandhill crane, common flicker, common crow, robin, starling, Brewer's blackbird, vesper sparrow, chipping sparrow, and field sparrow; breeding birds: Canada goose, marsh hawk, American kestrel, mourning dove, great horned owl, horned lark, western meadowlark, yellow-headed blackbird, red-winged blackbird, brown-headed cowbird, American goldfinch, lark sparrow.

Small mammal densities were somewhat higher than in upland croplands and one additional species, the house mouse, was found.

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APPENDIX

Appendix 1. Winter habitat use by birds on the Intake Study Area[1].

Species	Sample Size	Bottom Crops	Sagebrush Grassland	Hayfield	Xeric Hillsides	Hardwood Draw	Juniper Breaks	Riparian	Rose-Snowberry	Upland Crops	Upland Grassland
Golden eagle	22	9 (2.1)[2]	59 (3.6)	29			5	5		5	18
Bald eagle	14			10			7	57			7
Prairie falcon	10	20						10		40	20
Gray partridge	31	52 (12.4)									48 (1.1)
Great horned owl	10	30	20			10	10	10			20
Hairy woodpecker	5					60		40			
Horned lark	1452	18 (4.3)	tr	1						74 (10.0)	6
Black-billed magpie	406	1	8	1	1	45 (8.2)	8 (2.6)	34 (5.1)	tr	1	tr
Black-capped chickadee	54		6			37 (6.7)	11 (3.5)	46 (6.9)			
White-breasted nuthatch	6					17		83			
Townsend's solitaire	9						89	11			
Bohemian waxwing	1227					12 (2.2)	43 (15.5)	34 (5.1)		3	3
Northern shrike	18	28	50			6		11		6	
House sparrow[3]											
Gray crowned rosy finch	110				44 (3.7)		1			23 (2.1)	33
Common redpoll	77		7							39 (5.3)	61 (1.4)
Tree sparrow	43	12 (2.9)				19 (3.5)		28 (4.2)	19 (27.1)	12 (1.6)	5
Lapland longspur	996	14 (3.3)	1	1						85 (11.5)	tr
Snow bunting	213	1								97 (13.1)	1

[1] Table includes all species with 5 or more observations. Figures are percentages.

[2] Habitat Preference Index (only calculated when N=20).

[3] House sparrows only observed near homesteads throughout the year.

Appendix 2. Spring habitat use by birds on the Intake Study Area.[1]

Species	Sample Size	Bottom Crops	Sagebrush Grassland	Hayfields	Xeric Hillsides	Hardwood Draw	Juniper Breaks	Riparian	Rose-Snowberry	Upland Crops	Upland Grassland
Eared grebe	58		100[3]					100[4]			
White pelican	464							100[4]			
Great blue heron	31							90[4] (14.9)			
Canada goose	344	19 (4.5)[2]		2 (1.4)				[illegible][4] (x)		1	
Mallard	316	4	2	9 (6.4)		4[3]		[illegible][4] (x)		11 (1.5)	3
Gadwall	30							100[4]			
Pintail	67							97[4]		3	
Green-winged teal	60							100[4]			
Blue-winged teal	39			10 (7.1)				90[4] (x)			
American widgeon	13							100[4]			
Northern shoveler	25							20[4]		80 (10.8)	
Redhead	8		100[3]								
Common goldeneye	9							100[4]			
Ruddy duck	12		100[3]								
Common merganser	10							100[4]			
Turkey vulture	17	18	24	6	12	6		24		12	
Red-tailed hawk	19	11	32		5	5	5	26			16
Golden eagle	7		14	14			43	14			14
Bald eagle	32		6					91 (13.6)			3
Marsh hawk	38	5 (1.2)	18 (1.1)		5	3		3		21 (2.8)	45 (1.1)
Prairie falcon	6		17			17				33	33
Merlin	6		17		17			17			50
American kestrel	122	11 (2.6)	34 (2.1)	2 (1.4)		2	2	10 (1.5)		16 (2.2)	25
Gray partridge	16		6							31	62
Sandhill crane	40	100 (23.8)									
American coot	17		18[3]					82[4]			
Killdeer	54	2	44 (2.7)				6[3]	24[5] (3.6)			24
Willet	6							100[5]			
Long-billed dowitcher	9							100[5]			
Ring-billed gull	6							100[5]			
Franklin's gull	7							100[5]			
Rock dove	5			40	20			40			
Mourning dove	727	47 (11.2)	4	1	tr	2	1	4		24 (2.2)	16
Great horned owl	17		18			29	6	47			

Appendix 2 continued

Species	Sample Size	Bottom Crops	Sagebrush Grassland	Hayfields	Xeric Hillsides	Hardwood Draws	Juniper Breaks	Riparian	Rose-Snowberry	Upland Crops	Upland Grassland
Common flicker	98	6 (1.4)	30 (1.8)	2 (1.4)		15 (2.7)	5 (1.6)	36 (5.4)		2	4
Downy woodpecker	6					50		50			
Eastern kingbird	10	10	10							60	20
Western kingbird	27		11			7 (1.3)	7 (2.3)			30 (4.1)	44
Say's phoebe	20		15		5	5	45 (14.5)				30
Horned lark	326	3	7							40 (5.4)	50 (1.2)
Rough-winged swallow	7		71								29
Barn swallow	5										100
Black-billed magpie	247	1	11			16 (2.9)	18 (5.8)	17 (2.5)	1	1	34
Common crow	131	15 (3.6)	12	11 (7.9)		14 (2.5)		17 (2.5)		8 (1.1)	25
Black-capped chickadee	21					33 (6.0)	9 (2.9)	57 (8.5)			
House wren	8							100			
Rock wren	10		10		50		20				30
Gray catbird	5					40		60			
Brown thrasher	12		8			25	8	33		8	37
Robin	85	5 (1.2)	11	10 (7.1)		19 (3.5)		46 (6.9)		5	5
Mountain bluebird	35		64 (3.9)		6	3	11 (3.5)				17
Northern shrike	5	20	60			20					
Loggerhead shrike	22	5 (1.2)	32 (2.0)	5 (3.6)		5				14 (1.9)	41
Starling	165	13 (3.1)	23 (1.4)	31 (22.1)		7 (1.3)		25 (3.7)		2	
Yellow warbler	9					11		88			
Yellow-throat	6							83	17		
Yellow-breasted chat	7							100			
Western meadowlark	218	12 (2.9)	18 (1.1)	tr	tr	tr	1	37 (5.5)		30	30
Yellow-headed blackbird	6			57						12	12
Red-winged blackbird	191	4	6	35 (5.4)		3		76 (8.4)		2	2
Common grackle	45		2	49 (35.0)		16 (2.9)		33 (4.9)			
Brewer's blackbird	164	15 (3.6)	5	18 (12.9)		1	1	6		35	35
Brown-headed cowbird	208	8 (1.9)	85 (5.2)					3		3	3
American goldfinch	20					5		95 (14.2)			
Rufous-sided towee	31		6			23 (4.2)	29 (9.4)	32 (4.8)	3 (4.3)	6	6

Appendix 2 continued

Species	Sample Size	Bottom Crops	Sagebrush Grassland	Hayfields	Xeric Hillsides	Hardwood Draws	Juniper Breaks	Riparian	Rose-Snowberry	Upland Cropland	Upland Grassland
Lark bunting	65	2	3							28 (3.8)	68 (1.6)
Vesper sparrow	49	6 (1.4)	10		2		2	5		18 (2.4)	61 (1.4)
Lark sparrow	96		25 (1.5)	42 (30.0)			4 (1.3)	27		1	≤3
Dark-eyed junco	15		27				20	12 (1.8)	7		20
Tree sparrow	325	10 (2.4)	36 (2.2)			11 (2.0)			12 (17.1)	2	17
Chipping sparrow	92		2			23 (4.2)	4 (1.3)	30 (4.5)		19 (2.6)	52 (1.2)
Field sparrow	63		24 (1.5)			10 (1.8)	11 (3.5)	100	3 (4.3)		22
Song sparrow	10										
Lapland longspur	5									100	

[1] Table includes all species with 5 or more observations. Figures are percentages

[2] Habitat Preference INdex (only calculated when N=20).

[3] At reservoirs

[4] On river.

[5] Including riverbank.

Appendix 3. Summer habitat use by birds on the Intake Study Area.[1]

Species	Sample Size	Bottom Crops	Sagebrush Grassland	Hayfield	Xeric Hillside	Hardwood Draw	Juniper Breaks	Riparian	Rose-Snowberry	Upland Crops	Upland Grassland
Eared grebe	26		96[3]					4[4]			
White pelican	198							100[4]			
Great blue heron	85					4[3]		5[5] (14.3)			
Canada goose	218	60 (14.3)						40[4]			
Mallard	269					14[3]		0[5]		28 (3.8)	52[3]
American widgeon	6		100[3]								
Turkey vulture	42	5 (7.2)	[illegible]		21 (1.8)			26 (3.9)		10 (1.4)	21
Red-tailed hawk	12				8		8	33		8	33
Marsh hawk	16	12	31	6						16	44
Prairie falcon	5	20			20						60
American kestrel	164	7 (1.7)	19 (1.2)	2 (1.4)	5	1	4 (1.3)	10 (1.5)		16 (2.2)	37
Gray partridge	13		15				15				69
Killdeeer	75	3	47 (2.9)	1				22[5] (3.3)		3	24
Long-billed curlew	13		15							8	77
Upland sandpiper	17		65							18	24
Black-billed cuckoo	14					29		71			
Great horned owl	6	12	38	25		12		12			
Common nighthawk	94	6	[illegible]	11 (7.9)			1	66 (9.9)			2
Common flicker	111		[illegible]	9 (5.7)		10 (1.3)	6 (1.9)	39 (5.3)		2	3
Red-naded woodpecker	32	3	[illegible]			28 (5.1)		56 (8.4)			
Eastern kingbird	123	3	[illegible]	2 (8.5)	1	4	2	18 (2.7)		5	23
Western Kingbird	156	2	[illegible]	9 (6.4)		2	1	5		3	54
Say's Phoene	7				14		29			14	43
Least Flycatcher	5							100			
Western woodpewee	10					10	10	80			
Horned lark	50		[illegible]							6	88 (2.1)
Barn swallow	53			21 (15.0)		48 (8.7)				3	27
Blue jay	6							100			
Black-billed magpie	185	3	16	1	1	9 (1.6)	25 (8.1)	19 (2.8)			26
Common crow	109		2			6 (1.1)	1	60 (9.0)		3	29
Black-capped chickadee	19					32	11	58			
White-breasted nuthatch	6					33		67			
House wren	41			5 (3.6)		41 (7.5)		54 (8.1)			
Rock wren	27		11		81 (6.8)		7 (2.3)				

Appendix 3 continued

Species	Sample Size	Bottom Crops	Sagebrush Grassland	Hayfield	Xeric Hillside	Hardwood Draw	Juniper Breaks	Riparian	Rose-Snowberry	Upland Crops	Upland Grassland
Brown thrasher	37		14			54 (9.8)	5 (1.6)	24 (3.6)			3
Robin	113		15	2 (1.4)		29 (5.3)	3	47 (7.0)		4	1
Loggerhead shrike	31	3	6		3	3	10 (3.2)			19 (2.6)	55 (1.3)
Starling	122		23 (1.4)	7 (5.0)		1		68 (10.1)			2
Red-eyed vireo	9					44		56			
Yellow warbler	15					40	7	53			
Yellow throat	12		8			25		58	8		
Yellow-breasted chat	20					60 (10.9)		40 (5.0)			
American redstart	13					54		46			
Bobolink	9			11						88	
Yellow-headed blackbird	12	92								8	
Red-winged blackbird	276	68 (16.2)	25 (1.5)	tr		3			tr	1	2
Orchard oriole	6			17		50		33			
Common grackle	70		21 (1.3)	9 (6.4)		6 (1.1)		4		33 (4.5)	27
Brewer's blackbird	218		17	3 (2.1)		2				33 (4.5)	44
Brown-headed cowbird	250	26 (6.2)	66 (4.0)			2		1		tr	5
Lazuli bunting	12		3			17		75			
American goldfinch	281	7 (1.7)	9	tr		7 (1.3)	1	9 (1.3)		9 (1.1)	58 (1.4)
Rufous-sided towee	62		6			29 (7.1)	16 (4.8)	37 (5.5)			3
Lark bunting	109		11							40 (5.4)	49 (1.1)
Grasshopper sparrow	15		20							7	74
Vesper sparrow	23		15	3 (2.1)				3		3	76 (1.8)
Lark sparrow	194	10 (2.4)	39 (2.4)	1	1	8 (1.5)	5 (1.6)	14 (2.1)		2	21
Chipping sparrow	60	25 (6.0)					18 (5.8)	33 (5.7)		2	1
Field sparrows	94	2	14		1	30 (5.5)	7 (2.3)	35 (5.2)	3 (4.3)		7

1 Table includes all species with 5 or more observations. Figures are percentages.
2 Habitat Preference Index (only calculated when N=20).
3 At reservoirs.
4 On river.
5 Including riverbank.

Appendix 4. Fall habitat use by birds on the Intake Study Area.[1]

Species	Sample Size	Bottom Crops	Sagebrush Grasslands	Hayfield	Xeric Hillsides	Hardwood Draw	Juniper Breaks	Riparian	Rose-Snowberry	Upland Crops	Upland Grassland
Great blue heron	20							100[2](14.2)			
Canada goose	265	40 (95)[3]						38[4](x)		22 (3.0)	
Mallard	162		6[5]			2[5]		92[4](x)			
Gadwall	30							100[4]			
Green-winged teal	24							100[4]			
Blue-winged teal	27							100[4]			
American widgeon	32		41[5]					59[4]			
Redhead	8		100[5]								
Red-tailed hawk	5		60					20			20
Golden eagle	6	33	33							33	
Marsh hawk	11		18							64	18
Prairie falcon	10	20			10			20		10	40
American kestrel	132	8 (1.9)	18 (1.1)			2	1	15 (2.2)		22 (3.0)	34
Sandhill crane	162									100 (142.8)	
Killdeer	20	5 (1.2)						90[2](3.0)			15
Common snipe	6					17					83
Rock dove	33				100 (8.4)						
Great horned owl	8		25			25		38			12
Common flicker	67		34 (2.1)	3 (2.1)		21 (3.8)		33 (4.9)			8
Horned lark	28									4	96 (2.2)
Barn swallow	5					100					
Black-billed magpie	325	2	21 (1.3)	2 (1.4)	tr	16 (2.9)	17 (5.5)	28 (4.2)		5	10
Common crow	347	7 (1.7)	44 (2.7)			5		2		42 (5.7)	tr
Black-capped chickadee	45				4	62 (11.3)	24 (7.7)	9			
Robin	256					75 (13.6)	tr	2 (1.8)			12
Cedar waxwing	30					100 (18.2)					
Northern shrike	2	12								25	25
Starling	23							100(14.9)			
Yellow-rumped warbler	10					100					
MacGillivray's warbler	8					100					
Red-winged blackbird	16	100 (23.8)									

Appendix 4 continued.

Species	Sample Size	Bottom Crops	Sagebrush Grassland	Hayfields	Xeric Hillsides	Hardwood Draws	Juniper Breaks	Riparian	Rose-Snowberry	Upland Crops	Upland Grassland
Brewer's blackbird	52		4	23 (16.4)							73 (1.7)
Evening grosbeak	15					100					
Gray-crowned rosy finch	73						11 (3.5)				89 (2.1)
American goldfinch	55		2			24 (4.4)		4		27 (3.6)	44
Rufous-sided towee	55		2			65 (11.8)		22 (3.3)	7 (10.0)		4
Vesper sparrow	62	5 (1.2)	2			13 (2.4)		3		21 (2.8)	56 (1.3)
Lark sparrow	6		17							50	33
Dark-eyed junco	13		62	23				15			
Tree sparrow	21		10			14 (2.5)			67 (95.7)	10 (1.4)	
Chipping sparrow	53		25 (1.5)			34 (6.2)		23 (3.4)	19 (27.1)		
Field sparrow	93	13 (3.1)	13	10 (7.1)		34 (6.2)		6	13 (18.6)	6	5
Harris' sparrow	6								100		
Song sparrow	5					40				40	20
Lapland longspur	90	28 (6.7)								29 (3.9)	43

1 Table includes all species with 5 or more observations. Figures are percentages.
2 Including riverbank
3 Habitat Preference Index (only calculated when N=20)
4 On river
5 At reservoir

Appendix 5. Results of the breeding bird survey on the Intake Study Area.

	Bottom Cropland (7)[1]	Sagebrush Grassland (12)	Hayfields (9)	Xeric Hillsides (13)	Hardwood Draws (18)	Juniper Breaks (16)	Riparian (11)	Rose-Snowberry (5)	Upland Crops (18)	Upland Grassland (30)
Mallard			0.22/11							
Red-tail hawk	0.1/.14[2]						0.1/.09			
Ferruginous h.										
Marsh hawk						0.1/.06				0.1/.10
Kestrel				0.08/.08	0.16/.06		0.09/.09			.07/.07
Sharptail		0.1/.08								0.3/.13
Pheasant	0.7/.57	1.4/.58	2.00/89	2.1/.08	0.6/.39		1.3/.64		1.0/.67	0.4/.27
Killdeer	0.7/.14	0.2/.17	0.22/22							.03/.03
Long-billed curlew										0.06/0.03
Upland sandpiper										0.1/.13
Mourning dove	6.3/100	2.0/.75	0.89/56	0.5/.23	1.1/.56	0.7/.38	2.7/.91		10.2/100	3.3/0.80
Black-billed cuckoo			0.11/11		0.2/.22					
Night hawk						0.1/.12	0.09/.09		-.06/.06	.13/.10
Belted kingfisher							0.1/.09			
Common flicker		0.4/.42			0.3/.28		1.0/.73			.03/.03
Red-headed woodpecker							0.1/.09			
Eastern kingbird		0.3/.17	0.11/11		0.2/.17		0.4/.18		0.2/.11	
Western kingbird	0.3/.14	0.1/.08	0.44/33		0.1/.06		0.5/.36		0.1/.06	.03/.03
Say's phoebe				0.2/.15		0.1/.12				.03/.03
Least flycatcher					0.1/.06		0.2/.18			
Western wood pewee		0.1/.08			0.2/.22		1.0/.55			
Horned lark	0.6/.43	0.4/.17							1.3/.56	1.2/.63
Tree sparrow							0.2/.09			
Lark sparrow	0.1/.14									
Barn swallow									0.2/.11	
Black-billed magpie				0.1/.08	0.3/.22	0.4/.25	0.4/.27			0.23/.20
Common crow					0.3/.22		0.3/.18		0.4/.33	.07/.07
Black-capped chickadee					0.1/.06		0.1/.09			
House wren					0.8/.44		1.5/.64			
Rock wren				0.6/.46		0.4/.31				

Appendix 5 Continued .

	Bottom Cropland (7)	Sagebrush Grassland (12)	Hayfields (9)	Xeric Hillsides (13)	Hardwood Draws (18)	Juniper Breaks (16)	Riparian (11)	Rose-Snowberry (5)	Upland Crops (18)	Upland Grassland (30)
Gray catbird							0.2/.18			
Brown thrasher		0.2/.17			0.4/.33	0.06/.06				0.06/.06
Robin	0.4/.28	0.2/.17	0.11/11		0.8/.67	0.96/.06	0.8/.63		0.2/.17	
Mountain bluebird						0.06/.06				
Loggerhead shrike										.03/.03
Starling		0.1/.08	0.11/11		0.2/.11		0.3/.18			
Red-eyed vireo					0.2/.17		0.4/.36			
Black-white warbler						0.06/.06				
Yellow warbler		0.1/.08			1.1/.67		1.3/.81			
Yellowthroat							0.3/.27	2.0/.80		
Yellow-breasted chat					0.7/.44	0.06/.06	1.1/.45	1.0/100		
American redstart			0.11/11		0.6/.33		0.2/.27			
Bobolink			0.11/11							
Meadow lark	4.6/100	4.2/1.00	3.56/100	0.5/.46	0.1/.06	0.2/.19	0.6/.55		4.8/100	4.6/100
Red-winged blackbird	1.6/86	0.2/.17	2.89/89		0.4/.11				1.2/.39	0.10/.07
N. oriole					0.1/.11		0.1/.09			
Brewer's blackbird		0.5/.33			0.4/.22				0.6/.22	0.6/.33
Common grackle			0.44/33				0.2/.18			
Brown-headed cowbird		0.2/.17	0.33/22		0.3/.22		0.4/.27		0.1/.06	0.2/.07
Lazuli bunting					0.4/.39	0.06/.06	0.5/.45			
American goldfinch		0.1/.08	0.33/11		0.9/.67	0.2/.12	0.5/.27			
Rufus-sided towee		0.4/.33		0.2/.15	1.1/.61	1.6/.88	1.0/.55	1.0/.60		0.2/.17
Lark bunting	0.1/.14								0.9/.39	0.03/.03
Grasshopper sparrow									0.1/.11	0.5/.37
Vesper sparrow		0.2/.17				0.1/.12				0.6/.47
Lark sparrow		0.2/.17	0.22/11		0.2/.17	0.8/.50	0.2/.18	0.4/.20	0.1/.11	0.4/.23
Chipping sparrow					0.3/.22	0.9/.44	0.1/.09			
Clay-colored sparrow		0.1/.08								
Field sparrow	0.1/.14	1.6/.83		0.5/.46	0.9/.44	1.1/.62	0.6/.55	1.2/.80		0.3/.30

1 Number of counts
2 Average number of individuals per stop/percentage of stops where species was recorded.

Appendix 6. Winter habitat use by mammals on the Intake Study Area.[1]

Species	Sample Size	Bottom Crops	Sagebrush Grasslands	Hayfields	Xeric Hillsides	Hardwood Draws	Juniper Breaks	Riparian	Rose-Snowberry	Upland Crops	Upland Grassland
White-tailed jackrabbit	28		32[2](2.0)[3]	11 (7.9)		4				14 (1.9)	39
Desert cottontail	36		22 (1.3)		6	25 (4.5)	28 (9.0)	11 (1.6)		3	6
Porcupine	38		8			34 (6.2)	5 (1.6)	45 (6.7)		5	3
Eastern fox squirrel	6					17		33			
Bobcat	10					20	20	50			10

[1] Table includes all species with 5 or more observations excluding game mammals and coyote.
[2] Percentage of observations
[3] Habitat Preference Index (only calculated when N=20), where no preference was found, no index is given.

Appendix 7. Spring habitat use by mammals on the Intake Study Area.[1]

White-tailed jackrabbit	5		40							40	20
Desert cottontail	8		50			12	25		12		
Porcupine	6	17				33		33			17
Raccoon	6		17				17[2]	33		33	
Striped skunk	10		10	20				10		10	50

[1] Table includes all species with 5 or more observations. Figures are percentages.
[2] Near a reservoir

Appendix 8. Summer habitat use by mammals on the Intake Study Area.[1]

Species	Sample Size	Bottom Crops	Sagebrush Grassland	Hayfields	Xeric Hillsides	Hardwood Draws	Juniper Breaks	Riparian	Rose-Snowberry	Upland Crops	Upland Grassland
White-tailed jackrabbit	7		29[2]							43	29
Desert cottontail	25		76 (4.6)[3]	8 (5.7)	4		4 (1.3)			4	4
Porcupine	6			50		17		17			17
Raccoon	5					60				40	
Striped skunk	7	14	14			29		14	14		14

1 Table includes all species with 5 or more observations.
2 Percent of observations.
3 Habitat Preference INdex (only calculated when N=20). where no preference was found, no index is given.